AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 16, NO. 48. WEEKLY. | NEW YORK, THURSDAY, NOVEMBER 30, 1893. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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A New Drill Chuck.

We illustrate herewith a drill chuck which is designed to do away with some of the well recognized evils of the taper shank system, and especially to hold tools securely, even for under cutting, without the use of anything more than the hand in tightening the chuck. At Fig. 1 is shown a longitudinal section of the chuck as made directly upon the end of a drill press spindle, a form which is especially recommended by the makers where practicable, as it is claimed to be in most cases. By reference to this figure it will be seen that the spindle is bored to the Morse taper as usual, but that the shank of the tool, instead of being flatted at the end for driving, has a half-round groove milled into it, a steel key *A* fitting into this groove, and being forced to place by the upward movement of the steel ring *B*, this ring being moved by turning the knurled cap nut *C*, which is threaded to the spindle.

Owing to the fact that the groove in the shank is much deeper where the key engages it than above that point, there can be no dropping out of the tool from the spindle, even when the tool happens to be a heavy boring bar, used for facing or counterboring the under-side of work, as often happens, in the case of radial drills especially.

At Fig. 2 is shown a collet which is made upon much the same principle, this being provided with a hardened steel tongue *E* that answers the purpose of the key. These collets are made to the Morse taper inside and out, or tapering outside and parallel inside, thus enabling straight shank drills to be held in a taper chuck. This collet is also used to advantage in the turret lathe, and avoids the evil of having the shanks of valuable tools injured or destroyed by set-screws.

Where straight shank tools are to be held in a chuck similar to that shown at Fig. 1, the chuck is essentially the same, the only difference being in the hole for the reception of the shank and the inclination of the key upwards as shown in Fig. 3. In both Figs. 1 and 3, the dotted lines behind the key indicate a spring which tends to force the key outwards and disengage the shank when released. Fig. 4 shows the general appearance of the chuck as made with a shank to go into a spindle, and, of course, this shank may be of any required form.

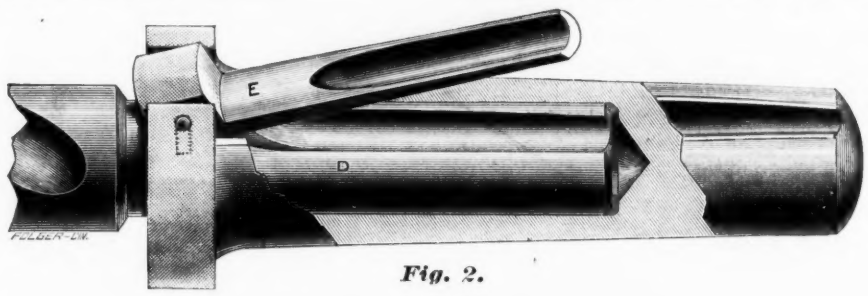


Fig. 2.

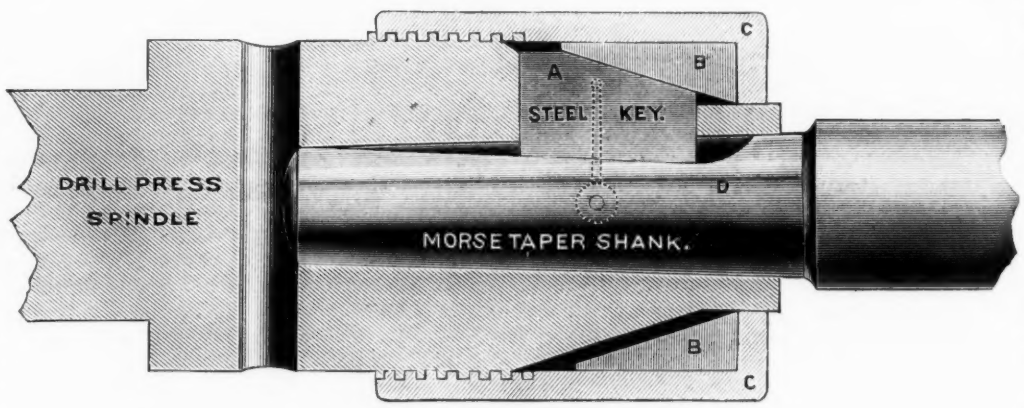


Fig. 1.

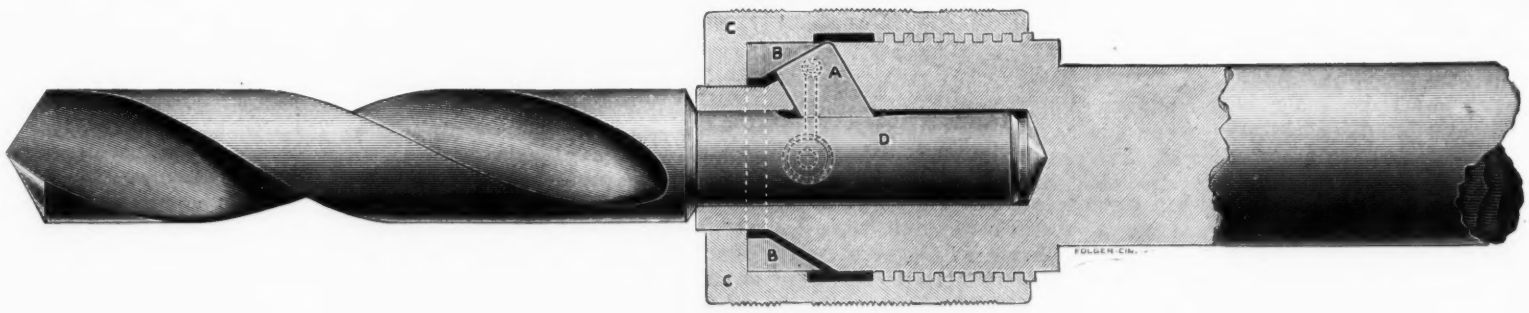


Fig. 3.

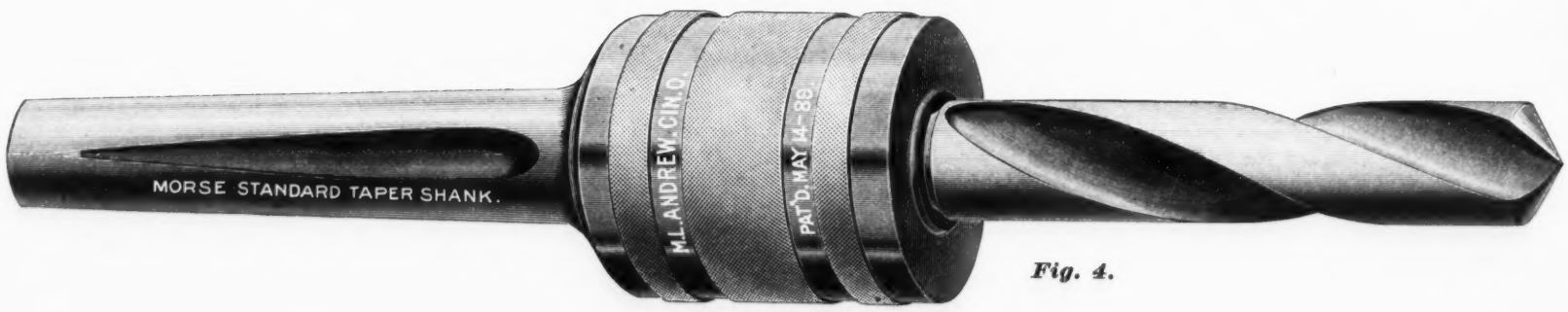


Fig. 4.

A NEW DRILL CHUCK.

Being entirely free from outside projections, holding the tools securely and driving them positively by engagement with the strongest portion of the shank as this does, it will be seen that it possesses peculiar merits, and it has been used in some well-known machine shops with entire satisfaction. Five sizes of both the taper and straight shank chucks and four sizes of the collets are made by M. L. Andrew & Co., Cincinnati, O.

Economical Air Compression.

BY FRANK RICHARDS.

THE ECONOMY THAT MAY BE EFFECTED WHEN COMPRESSING IN A SINGLE CYLINDER.

In the AMERICAN MACHINIST, September 21st, I was saying something about the economy that may be accomplished, or defeated, in the first operation of air compression, that of getting the air into the compression cylinder, and hinting that under existing arrangements an unnecessary waste of power may be constantly occurring and ranging perhaps as high as 10 per cent. Since writing that my attention was attracted to a paper upon Blowing Engines, by Mr. Julian Kennedy, of Pittsburgh, read before the Mining Engineering Division of the World's Engineering Congress at Chicago.

Mr. Kennedy says: "This heating of the incoming air expands it, and proportionately reduces the weight of air entering the cylinder at each stroke. I have observed this in the case of an engine which was so constructed as to cause the air to travel about 3 inches over the hot metal in thin films $\frac{3}{16}$" thick. Alongside of it was another engine of the same size and make, except that valves were used which allowed the air to pass over about 1 inch of metal, the openings being of such size that each stream of air was 2 inches in thickness. Careful and repeated tests of these engines, when both were in good order, showed that, while the indicator diagrams were practically the same, the one with the large valves would burn about 10 per cent. more coke in the furnaces, a result which could only be explained on the supposition that, in the case of the engine with the small air openings, the incoming air, in passing through the small and tortuous passages in the heads, was heated about 25° C. more than in the case of the other engine."

The above, it should be remembered, speaks only of blowing engines, where the air pressures are low and the heat of compression and the heating of the parts in contact with the compressed air do not range high. In an air compressor every part of the cylinder in contact with the air naturally becomes much hotter, and the heating of the incoming air may be much greater than Mr. Kennedy here speaks of.

The air remaining in the clearance space of the cylinder is between the hot cylinder head and the hot piston, so that it can have lost but little of its heat of compression, and all of the heat thus retained is added to or mixed with the new body of air admitted to the cylinder to be compressed at the next stroke. It is probable that in this connection the clearance space in the air cylinder assumes its greatest economic importance. The desirability of keeping the clearance as small as possible, so that the amount of hot

air retained to be mixed with the incoming air may be as small as possible, must be obvious.

The air compressors now most generally in use have horizontal, double-acting air cylinders more or less completely water jacketed and with various devices for heads, valves, pistons, etc. Whether they prevail through the operation of the law of natural selection, and the survival of the fittest, one may not rashly say. It may be that the law has not yet become operative upon them. In our quest of economy during compression we can then look first at these compressors in which the compression is effected in the single cylinder, and completed at a single operation.

Supposing that we are filling the air cylinder by the natural inflow of the air under the pressure of the surrounding atmosphere, and that we have got into the cylinder the greatest possible actual weight or quantity of air under those conditions, which means that our air is little, if any, below the density of the surrounding air from which it is drawn, and assuming that the air is also as cool as we can get it, we may then be said to have got our material as cheaply as possible, to have started our business under the most favorable conditions, and with encouraging prospects. and we may then, and not until then, consistently and without reproach look for the available means of economy in the actual operation of compression. The same considerations that tend to economy in the procuring of the air, or in getting it into the cylinder, hold good also in all the subsequent operation of compression. The smaller the bulk or volume of any given quantity or weight of air the cheaper can the compression be effected and the better the economy, and as the volume of the air at any given pressure depends upon its temperature the supreme consideration throughout the operation is to keep the air as cool as possible. The question of temperature has its whole bearing upon the economics of the case only as it affects the volume of air operated upon. While, as we know, practical air compression has not as yet come down to the minute economics, where eventually the profits of legitimate business are to be sought, still the enormous losses that are possible in compression and the great gains that are to be effected by avoiding or overcoming those losses have received more or less attention from the compressor builders.

Keeping the air cool during compression means actually cooling the air during compression. No compression can be effected without a corresponding rise of temperature in the air compressed. Theoretically the rise will be constant where the conditions are identical. Starting with the air at a given pressure and temperature, and compressing to another and higher pressure, the resulting temperature and volume should always be the same. Practically the temperature of the air after compression or during compression is never as high as the theoretical temperature, or as high as the books and tables say that it should be, and is also widely variable under apparently slight changes of conditions. This is not at all because the theory in the case is incorrect, but rather that it is incomplete in that it is not cognizant of all the conditions that affect the case. Theory says, and correctly, that the element of time has nothing to do with the heat of compression, that a given volume of air when compressed to another given volume will have its temperature raised so much, whether it takes a minute, an hour, or a week to do it. Practically time has a great deal to do with the case. The readiness with which the air will receive heat from or impart its heat to whatever may be in contact with it, and the small amount of heat that suffices to change its volume, render the actual volume a highly elusive quantity, and time becomes a playground for it. In a compression cylinder in active use all the parts of it—the body of the cylinder, the heads, the piston and rod, the valves and seats or guides—all become heated by their contact with the compressed air, but while they are thus becoming heated they are only heated by this contact, and while being heated they are also being cooled, as they are constantly transmitting some of the heat received from the air and dispersing it by conduction or radiation, and consequently these parts are never as hot as the air that heats them—when the air is at its hottest—and the air also is not as hot as it would have been but for its contact with them. The metallic parts after a time of continuous operation attain an average temperature, and will not get any hotter. The mean temperature attained will depend upon the facilities provided for taking the heat away. Nothing better is known or has been suggested for conveying away the heat than cold water. It is now the common practice to make the shell of the cylinder double with a water space between the two shells, and where the style and arrangement of the valves permit the heads also are made hollow with water circulating in them. Water has also in some cases been circulated in the body of the piston. These arrangements undoubtedly help to reduce the mean temperature of the parts and make them more effective in cooling the air.

The heat of compression is abstracted from the air mostly at the latter part of each stroke, when the air is at its hottest and when the difference in temperature between the air and its surroundings is the greatest. Indeed it is to be supposed that in active compression the air loses none of its heat of compression during the earlier part of the stroke unless the means of cooling the cylinder parts are efficient and operative. If at the beginning of the stroke the cylinder is hotter than the air, the air is naturally heated rather than cooled by the contact. I have had practical evidence of this. I have taken air cylinder cards, such as Fig. 1—which, however, is not to be looked upon as an actual card from any existing compressor—where the compression line would not leave the adiabatic line until the first quarter of the stroke was traversed. In this connection it may be remarked that for evidence upon the point that we are considering any indicator cards that are taken when a compressor has just been started, and before the cylinder parts have attained their full average heat, are not to be accepted. Such cards promise better than the actual performance of the compressor.

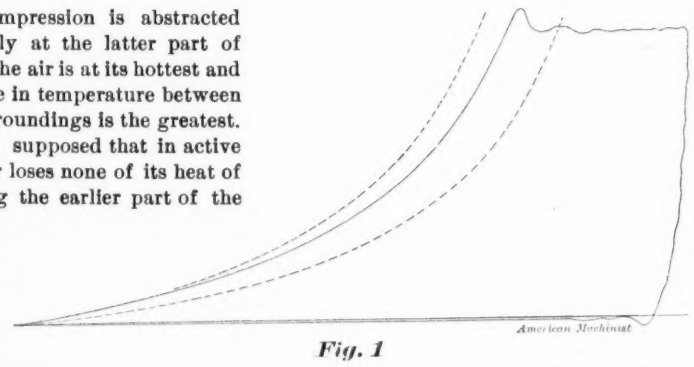


Fig. 1

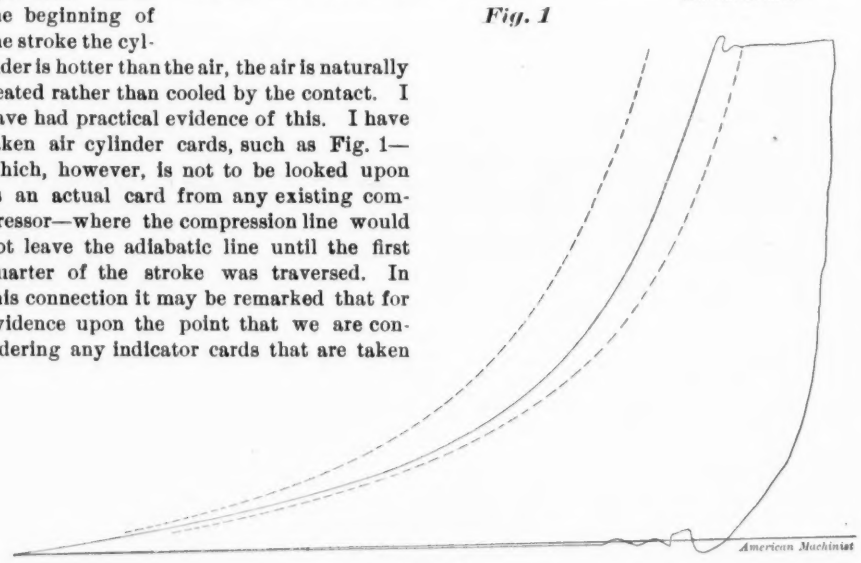


Fig. 2

ECONOMICAL AIR COMPRESSION.

The heating of the air does not continue throughout the whole stroke of the piston, but is accomplished and ceases at the moment that the full pressure is reached, and for the remainder of the stroke, while the compressed air is being ejected from the cylinder the air is becoming somewhat cooler, while the metal inclosing it is becoming hotter. The heat of the cylinder is not uniformly distributed. The ends of the cylinder and the cylinder heads being exposed to the air when it is hottest naturally become hotter than the middle of the cylinder which never feels the hottest air. The importance of the water jacket, in the absence of any better cooling device, is obvious enough. The effect of the water cooling is greater when applied to the cylinder heads than anywhere else because they are exposed to the heated air for the whole stroke, while the surface of the cylinder itself is covered by the advancing piston. Apart from its cooling function, the water jacket is a necessity as affecting the lubrication of the surfaces. Without some such means of cooling the cylinder would become so heated as to burn the oil and render it useless as a lubricant.

What cooling of the air is actually affected and what saving of power is accomplished by complete water jacketing? From all that I have been able to observe, I think we may say that when compressing in a single cylinder to from 60 to 80 pounds gauge pressure, and at a piston speed not exceeding 300 feet per minute, one-half of the total possible cooling is all that can be safely claimed for it. This, I think, can be depended upon to be accomplished, although I will not undertake to show where it is accomplished at this writing. If we can make a compression line midway between the adiabatic and the isothermal curves, we are leaving but a narrow margin for further saving, and if the saving is to be accomplished by complications of machinery and additional cost of maintenance it will be but a doubtful gain.

The device of cooling the air by the injection of a spray of water into the cylinder is probably the most effective cooling arrangement that has ever been devised, but collateral objections have driven it completely out of use in all new compressors, at least in the United States. The success of the spray is entirely dependent upon the mode of its application. The spray can only possibly effect the intended purpose when diffused through the air while being compressed. It can only cool the air while it is being heated, so that to admit it with the incoming air is only to let it fall inert to the bottom of the cylinder. It may have its useful effect in filling the clearance space but it can have little cooling effect upon the air. It may also make it unsafe to run the compressor at a speed that would be otherwise safe and proper. With the use of water in the compression cylinder, whether properly injected or not, no satisfactory means of lubricating the parts has ever been found, so that the friction of the piston and the loss of power by that means is greater than with other systems of compression. The piston and cylinder surfaces also wear away rapidly so that the repair cost and inconvenience is greater than with any other system. While there is no compressor builder, that I know of, who is now offering a compressor furnished with injection pumps, there is no objection to any builders retaining in their catalogues, as they do, the current arguments against the water injection because it helps to give the catalogue a formidable appearance, you know.

The size of the compression cylinder is a thing to be thought of in the consideration of economical compression. Other things being equal a small cylinder has a decided advantage over a large one. In a large cylinder the portion of air immediately in contact or lying near its water-cooled surfaces will be cooled by the contact, but the air in the middle of the cylinder will be little and slowly affected. A number of small compressors will show better results, so far as they depend upon the cooling of the air, than a large compressor can show. This has something to do with the indicator card that I now have the pleasure of offering. In the AMERICAN MACHINIST, March 9th, I showed a card from the air cylinder of a standard compressor with the remark that I considered it in most respects an excellent card. A correspondent, who modestly signed himself "B.," was not satisfied with my card, and submitted an idealized and impossible one which he claimed was better. Although I have not heard from him since, I may assume that he is still alive, and I take pleasure in calling his attention to the accompanying card, Fig. 2, which I have no hesitation in saying is the best and most satisfactory card made by a single compression that I have ever seen. This card, Scale 30, was taken from one of a series of small compression cylinders entirely submerged in water. The speed was not slow, 96 revolutions, so that the result is remarkable. The card has not been "monkeyed with" in any way. The delivery line has not been doctored. The compressor was built by Mr. Samuel E. Jarvis, Lansing, Mich.

Notes from the Fair.

Editorial Correspondence.

As one is about to pass through the main entrance to Transportation Building, he may see—done up in staff—at his left a representation of primitive methods of travel in the form of the two-wheeled—slab wheels—vehicle drawn by oxen, with the head of the family seated in front, and the mother and little one at the rear, while at the right is a representation of the interior of a modern palace car and its occupants. The tendency of human nature is to pity him of the early methods without much thought as to whether he did not get just about as much of enjoyment out of his travelings as the traveler of to day gets.

Inside the building the matter is not carried quite so far, although some ancient vehicles are shown by way of contrast with those of modern design and luxurious appointments, and some current methods of traveling in remote countries where fashions change slowly, if at all, are represented.

In locomotives there is about all that could be desired to lead the observer along from the early days—not so very long ago—of this interesting machine up to the latest developments. The old locomotives, with which one may well begin, are largely representatives in wood, more or less faithful, that is with more or less imagination invoked to help the real over hard spots. The pictures of some of them have done duty in print. Very few of them, as has been pointed out, specifically with reference to English engines, by a writer in these columns, compare favorably with contemporaneous skill and design as evidenced in other machines and machinery of even date, which is perhaps what might be expected when it is considered that railroading was most decidedly in its experimental stages when these relics were built. But this does not take from the interest that attaches to them as links in the chain of progress. It was a happy thought to represent them here in tangible form, and by pictures and drawings.

In more modern locomotives there are 62, I believe, the greatest number—52—being from the United States, the remaining ten being divided between England, France, Germany and Canada; 20 of these are compounds. In these exhibits I cannot see that the United States suffers by comparison, and this is probably just what a

resident of any other country represented would say in reference to the exhibits from that country.

With the construction of most of these engines readers of technical literature are more or less familiar. One of them, an English locomotive, not very modern, however, has single drivers eight feet in diameter, which look particularly large to those accustomed to see American locomotives only, and which are large in fact anywhere. This is the famous "Lord of the Isles," which made high speed more than a generation ago.

The Winby locomotive (English) is as yet something of a novelty in its way. It has four cylinders, all high pressure, and four driving wheels. Two of the cylinders are outside connected to the rear driving wheels, and two are inside connected to the forward wheels. The steam distribution for one pair of cylinders is by the ordinary shifting link, and for the other pair by the Joy gear. The two pairs of drivers are not coupled, the cylinders for each pair doing their work quite independently of the other pair. The reverse lever is common to all the cylinders. The general make-up of this locomotive—helical springs, oval boiler and all—is hardly such as to inspire confidence, which is quite a different thing from saying that it may not be a mighty good machine.

The German locomotives—two in number, one a compound—from the State railways, are in some sense peculiar to that country. One is a switching engine—tank engine—with the tank situated between the boiler and the track, or roadway, the valve motion being outside. If there is any virtue in keeping the center of gravity low, this disposition of the tank assists to that end. The German compound is a two-cylinder engine. Holes are drilled in the stay bolts to enable breakage to be detected, as is common, and not only this but everything—including the plate frames—that would otherwise cover these holes is perforated.

The French locomotives possess more or less peculiarities of construction, as is always the case. One of them is fitted with releasing valve gear, which looks as if it ought to go to pieces inside of ten miles, but which evidently does nothing of the kind.

Altogether the exhibits of locomotives from different parts of this country and from Europe are interesting. The difference in practice as between this and foreign countries may be taken as representing to some extent difference in opinion, but to a greater extent, probably, different conditions under which such machines are worked in different countries, and other things that should be considered before judgment as to relative merits is passed. In conclusion I cannot do better than to quote from a paper read before the Western Railway Club by Mr. E. M. Herr:

"The prevalence of different features of design and construction among so large a number of locomotives exhibited as leading types of design by so many different builders is interesting, as showing the extent to which these features are probably coming into general use. Data collected with this end in view show that 34.6 per cent. of all the American locomotives exhibited are compounds, while of the foreign engines 30 per cent. are compound. Taking the whole exhibit, foreign and domestic together, almost exactly 34 per cent. are compounds. There are three distinct types of guides and crossheads used, viz., the Laird, two-bar, and four-bar designs. Of the United States locomotives, 80½ per cent. have Laird guides, 7.3 per cent. two-bar, and 12.2 per cent. four-bar guides. Of the foreign engines, 27 per cent. have Laird guides, 55 per cent. two-bar, and 18 per cent. four-bar guides. As to the design of four-wheel engine trucks, 52 per cent. of the United States locomotives having this truck have the rigid center design, and 48 per cent. the swing center. Iron tender frames are found on 45 per cent. of the tenders of United States engines, the remaining 55 per cent. have wooden frames. Of the boilers on these engines 46 per cent. are radial stay, 19 per cent. Belpaire, 31 per cent. crownbar, and 4 per cent. Wootten. The demand for higher steam pressures is well known, but it will probably surprise many that the average steam pressure of all United States road engines exhibited is 176.3 pounds. The average for all American engines, excepting the light locomotives built by H. K. Porter & Co., is 173 pounds, and the average of the entire American exhibit 169.3 pounds. European practice seems to run to even higher pressure, the average of these engines exhibited being 181.7 pounds.

"We have here before us the results of about 64 years' experience in locomotive design and construction in almost every country on the globe. Each company has its own conditions and peculiar needs, and it is not remarkable that considerable variety of design and practice should result. In fact, many differences in practice are essential to the highest development on account of the difference in conditions, and an effort to avoid them would be a step backward. There are many points in common, however, and it is by a critical inspection and comparison of such points in the wonderful display of locomotive machinery set before us at the Columbian Exposition that we can give and take with our guests and neighbors, and all be benefited and all enabled to assist in pushing the already almost marvelous development of railway machinery to a degree of perfection."

In this building are a large number of steamship models, including some of the British battle ships and cruisers. The Cunard Steamship Company have nine such models, including that of their first ship, the "Britannic," and one of their latest, the "Campania." Then they have diagrams of 16 ships, intended to show the progress in the size of ocean steamships. Below is a list of these, with their lengths, horse-power of engines, and date of completion:

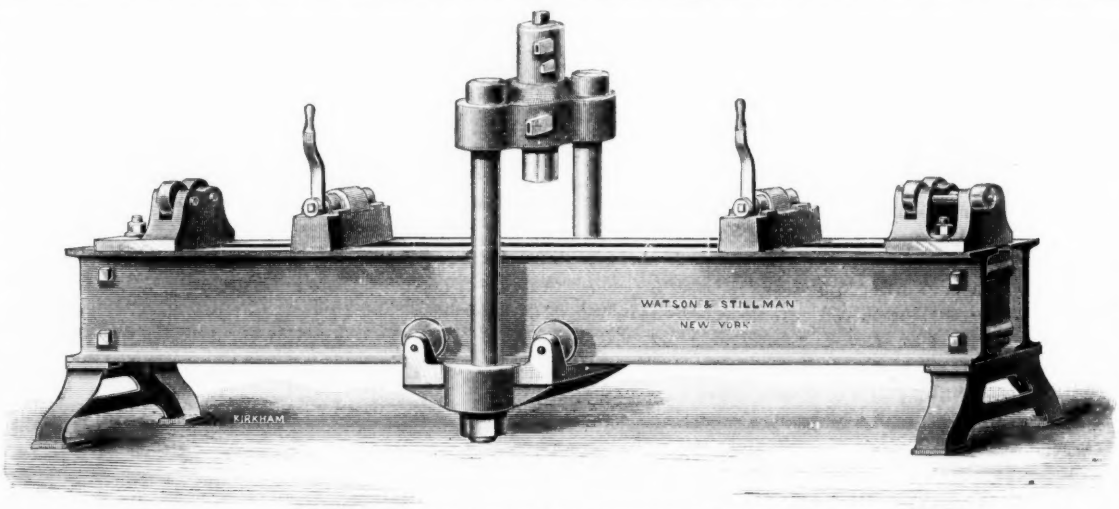
Name.	Date.	Length in feet between perpendiculars	Horse-Power.
Britannic	1840	207	740
Hibernia	1843	210	1,040
America	1848	251	2,600
Asia	1850	266	2,400
Arabia	1852	285	3,250
Persia	1855	376	4,000
Scotia	1862	379	4,800
China	1862	326	2,250
Java	1865	337	2,650
Russia	1867	358	3,160
Bothnia	1874	420	3,250
Gallia	1879	450	5,300
Servia	1881	515	9,900
Aurania	1882	470	9,900
Umbria	1884	500	14,500
Campania	1893	600	26,000

There was, as will be seen, a steady increase in the length from the "Britannic" up to the "Scotia," which was the last of the side wheelers, the length having reached 379 feet and the horse-power 4,800. Then came the "China," a screw propeller with a length of only 326 feet and 2,250 horse-power, a falling off in power much greater proportionately than the decrease in length. From this length and horse-power were increased until the "Servia" was built, in 1881. At the time this vessel was built, or directly afterwards, there were numerous predictions of her failure owing to her (then) great length and narrow beam. It was predicted that she would break in two, capsize, and suffer various mishaps. Engineers were not wanting who expressed the belief that it was little less than criminal to put such a vessel into service. Whether or not the company thought the matter overdone, the next two vessels were shorter, but finally fear, if there was any, was pushed aside and the "Campania" was built, with a length of 600 feet and engines of 26,000 horse power. All this—from the "Britannic's" 207 feet in length and engines of 740 horse-power to the "Campania's" 600 feet long and engines of 26,000 horse-power—in scarcely more than fifty years sets one thinking what the next fifty years will bring forth.

Just what a 12-inch rifled cannon has to do with transportation is not quite evident, still the one shown in the exhibit of the Bethlehem Iron Co. will transport a shot weighing 850 pounds at a velocity of 2,000 feet per second when backed with a charge of 425 pounds of powder. This gun is 36 feet 9 inches in length, 3 feet 6 inches greatest diameter and weighs 102,100 pounds. It looks large enough to do all the mischief necessary, although it is considerably less than half the weight of the 16.54 inch Krupp gun, the charge of powder being less than one-half as great and the weight of shot scarcely more than one third as great.

In the Bethlehem Company's exhibit is a model of the 125-ton hammer, designed by John Fritz and about which so much has been written. Here is a case in which there is sense in making the "biggest in the world." There are uses for its 125 tons of falling matter, and no doubt it will not long remain the biggest. This hammer stands 90 feet high from the floor, has a piston rod 40 feet in length and a stroke of 16½ feet. The weight of hammer and foundations is 2,400 tons. There are also shown armor plates, one 17 inches thick, a jacket weighing 25 tons as forged for a 13 inch gun, a model of a 112-ton ingot, single and double throw cranks, a spare shaft for the steamer "Pilgrim," hollow forged and finished, weighing 39½ tons, and various other heavy forgings, mostly suggestive of war.

The Link Belt Engineering Company, of New York and Philadelphia, and the Link Belt Machinery Company, of Chicago, have a combined exhibit in the Transportation Building annex, in which are shown in operation a half dozen ways of handling coal and other material, in which some application of link belt and link belt machinery are the agents employed. The machinery of their exhibit is driven by manila ropes. These companies have made a great success in their line, some idea of which can be had from their exhibit. H.



HYDRAULIC SHAFT-STRAIGHTENING PRESS.

Hydraulic Shaft-Straightening Press.

The engraving presented herewith is of a hydraulic shaft-straightening press, the bed of which consists of two 12" wrought I-beams tied together at the ends by distance pieces and bolts. At either end of this is a head supporting rollers upon which the shaft to be straightened is laid and revolved by motion imparted by a belt running on the small pulley seen at the extreme right. The bending blocks upon which the shaft rests while being bent are movable along the bed, and are provided with cams worked by levers, which raise the shaft clear of the rollers; thus in working the machine, the movement of these levers stops the rotation of the shaft, and at the same time brings it to rest upon the blocks.

The press proper is of special design and is mounted in a steel frame which is supported upon rollers running on the lower flanges of the I-beams as shown. The press ram can be moved up or run down onto the work without the labor of pumping by means of a lever inserted in the lower one of the two sockets shown in the cut, or it can be made to return automatically. The extreme motion of which the jack is capable is 4", and its power is sufficient to bend a 4½" shaft or bar when supported upon the blocks placed 2 feet apart. With 12 foot I-beams (the usual length) the machine weighs about 2,050 pounds. It is made by the W. & S. Hydraulic Machinery Works, 210 East Forty-third street, New York City. A similar press is made for straightening car axles and similar work upon centers.

Ferry-boat "Netherlands."

On the 20th inst. the Hoboken Ferry Company made a trial trip with their new screw ferry-boat "Netherlands." The results of the trial proved to be highly satisfactory to her designers and builders, and exceedingly pleasant to the many invited guests

Those who have occasion to cross the river daily, may, by becoming accustomed with the general appearance of ferry-boats, come to the conclusion that to design one is an exceedingly simple matter. But when such a radical departure is made from former designs, for instance, as the adoption of screw propellers in place of paddle wheels, and compound engines in place of beam engines, the designer is confronted with problems exceedingly difficult to solve. Even in the design of any kind of ferry boat the designer has to deal with problems which will tax his ingenuity. He has to deal with the stability of the vessel, which must not be greater than is necessary for safety, as a great stability is injurious to the ferry slips. He has also to take into account the longitudinal stability under a heavy load on the bow, and under all conditions of loading, steering and maneuvering power, and adaptability to varying loads, which may consist of a hand baggage truck or team loads aggregating many tons. Strength of hull compatible with minimum weight, good shape of hull for running through ice, limitation of draught, usually about 11 feet, and prompt response in the engine-room to the pilot's signals, must also receive a share of careful attention and thoughtful consideration. The engines must be well balanced and designed for a great variation of power. They must be simple in construction, strong and easy to operate, and all parts should be readily accessible for repairs and inspection. There are also many minor details of construction which must not be overlooked by the designer.

The screw-boat "Bergen," the first one built for the Hoboken Ferry Company, met the foregoing conditions to a great extent, and proved to be successful in service and became a popular boat. Her shaft, which in this class of boats extends throughout the whole length of boat, kept in line, it did

not break, neither did its bearings heat, nor did the propeller blades break in running through ice, as was prophesied. But experience showed that there were details in construction which could be improved in a future boat. It was found that after stopping the engines in the "Bergen," the boat could not be as readily steered as desired; to avoid this fault, the shape of the hull of the "Netherlands" was somewhat changed, the breadth of the rudder increased, and a three-bladed propeller of 11 feet pitch adopted instead of a four bladed one 9 feet 3 inches pitch, as was used in the "Bergen." The latter boat has a triple expansion engine 18½, 26, 42 by 24 inch stroke. The "Netherlands" has two compound engines 18 and 38 by 28 inches stroke. The increase of stroke was taken on account of the increase of pitch of wheel. These engines are similar in design to those on the ferry-boats "Bremen" and Hamburg," in the service of the same company, illustrated and described in our issue of October 1, 1891 The engines were built by W. & A. Fletcher Company, Hoboken, N. J. The engines worked very smoothly and satisfactorily. During a preliminary trial trip of the "Netherlands," the following results were obtained: Boiler pressure in pounds per square inch above atmosphere, 100.8; vacuum in inches of mercury, 25.8; revolutions per minute—average for time the engine was tested, 119; average horse power of main engine, 737.13; ratio of expansion from point of cut-off, 13.20; steam per hour per horse-power of engines for all purposes, 19.88 lbs.; steam per hour per horse-power of main engine, 16.85 lbs.; speed in statute miles per hour, 12 4; per cent. of slip, 14.8; boiler evaporation from temperature of hot well and actual pressure, 8 5.

There are also other improvements, among which may be mentioned the arrangement for blowing the whistle automatically in a fog giving the signals customary to the Hoboken ferries. We also noticed in the pilot house an electric gear for starting, stopping and reversing the engines directly from the pilot house, whereby a more complete control of the vessel is given to the pilot. During the last trial trip it was not in use, but we were informed that it worked well in a previous test. This arrangement does not possess the simplicity so desirable on a ferry boat, and therefore the officers of the company are somewhat undecided as to its general adoption, and regard it as more or less experimental. We can, however, say that Col. E. A. Stevens, president of the Hoboken ferries, is an enthusiast in the progress of ferry-boat construction, and no new design of any attachment that will promote the safety, comfort and rapid transportation of his patrons will be left untried. We are indebted for the foregoing data to the courtesy of Col. E. A. Stevens and to Capt. C. W. Woolsey, superintendent of the ferry.

Blank Flanges—Shop Ethics—Forfeits—Cylinder Heads.

By Fred H. Colvin.

One of the delusions in some compound engine plants is in thinking how readily they can change from compound to simple running, with either side, and then find that the change can be made only by putting in the "blank flange," as it is called, to block off the pipe.

This usually consists of a plain iron disk, of the same diameter as the flange in the pipe to be altered, but before this can be put in place, we must take out the cast iron ring of the same thickness, which takes its place when the pipe is left open.

These are usually about an inch thick, and in order to make the change it is necessary to take out every bolt in the joint, break the joint, and substitute the disk for the ring, then make up the joint again and go ahead. But this takes more time than it takes to tell of it, and when the pipes are hot, and the change has to be made in a hurry, it is not nearly so convenient as to simply close a valve. The valve costs more I know, but the convenience will more than repay it if the change needs to be made in working hours, and few places care to shut down while the pipes cool and the change is made.

When anything happens that makes a change from compound to simple running advisable, it does not wait till six o'clock in order to give you time to make the change during the night, but it usually happens at your busiest time, when a shutdown is expensive to say the least. The cost of valves is slight when compared with the cost of three or four changes, and valves should be used in every place where possible.

This naturally leads to the question as to what the economical point would be to make the change from compound to simple running on reduction of load, or whether it is better to run compound, and drop the pressure to the desired point to do the work on economical cut-off.

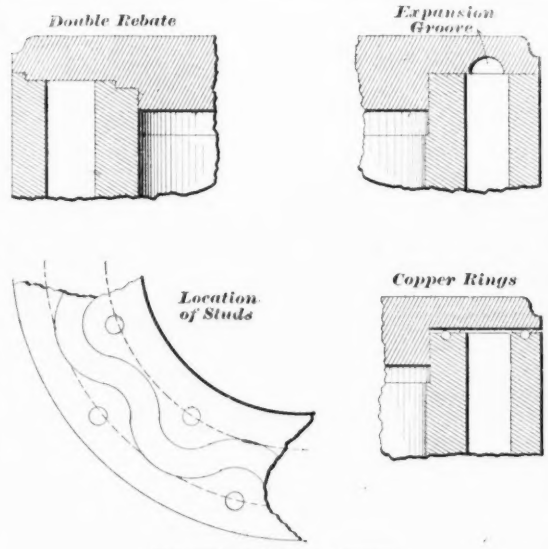
There are advocates of both systems and a little discussion on these subjects would be of general interest to readers interested in engine running. When running with a very light load, and keeping the steam pressure to the normal, the cut off is so short as to really be but a momentary impulse of steam against the piston, much as in the gas engine, and this succession of impulses or pushes is decidedly hard on machinery. In fact in simple engine running there are many who advocate a longer cut-off than is usually considered economical, for no other reason than to have a more uniform motion or pressure against the piston, and claim that the coal lost in extra steam is more than saved in absence of little annoying accidents to belts and pulleys. These latter are attributed to the series of impulses that give quick, sudden strains to the belts and machinery, and do damage in that way. The remedy advised by these men is to lower the steam pressure till the cut-off will not occur at less than ¼ stroke, and some advocate a little more, although this will give fair economy, and still have a more uniform motion and better governing properties than a shorter point of cut-off.

I came across a question in shop ethics the other day that may be of interest, as it no doubt has its likeness in many a shop besides the one in question. A certain piece of work was brought in by a neighboring firm to be done, as they had no facilities for doing the work. The work was put on the mill, and the agreement was that the work should be paid for at a certain rate while it was being worked upon—a high rate, too, by the way.

Instead of doing the work as they would have done it for themselves, by putting several tools at work, it was done one at a time, and after this laborious way of doing the work, it was found necessary to rebore some of the holes in order to have them line up. Nor was this all; for after all this extra work the main portion of the work had to be scraped to size and trueness, as the tools were not in good condition, and failed to do good work, making this extra work, which should have been unnecessary. The question becomes: Is it right or just to ask pay for all this work, which should have been unnecessary? As for the time consumed in doing the work by the use of only one tool at a time, unless the contract specified this it could probably not be taken from the bill, although morally it was not right to charge for time that was unnecessary. But it does not seem as though any one could collect pay for the extra scraping work which was done to patch out a poor job on the machine, and it seems as though a vigorous protest ought to bring about a re-adjustment of the terms of the bill. There are many cases similar to this, and the payment of unjust bills of this sort should be looked into more than is apt to be the case.

There is something amusing as well as expensive in the forfeiture of money for failure to complete work on time. when the forfeit is a majority of the contract, and it also shows poor management in some department, either in the office or shop, or both. If the contract time is too short for the completion of the work in good shape, the office is to blame, but if the time is long enough for ordinary construction, and the shop management cannot or will not plan the work so as to have it done on time, then the blame lies there. And it is very often the fault of both departments in not working together, or in not consulting about the time before the contract was taken. One instance I know of is where the contract was for $12.000, and had a forfeit of $100 per day for every day delayed. This contract was 90 days behindhand, and this left $3 000 out of the $12.000 as the money to be paid; the case isn't settled yet. In another instance, in which the forfeit was but $1 per day, the work was nearly a year behind, and while the money in this case is not such an object, the reputation of being so much behind was hardly one to be sought after. In both these instances the writer knows that the blame belongs to the shop management, and not to the office, and it shows that unless the shop is run as it should be, it will defeat the best business management possible.

There is seldom any need of this kind of work, for if the time is set too short the force can be worked more hours, or more men can be put on, and the time hurried very much, and, if necessary, offer a premium to the men for extra speed, and take care not to get caught next time. If work is properly planned, the time necessary for its performance carefully estimated, and the details looked after, it is possible to hurry work without any apparent exertion, but too many have not this faculty, and as a consequence the work lags, and the forfeits have to be paid.



Cylinder Head Joints.

One of the all-important features about cylinder heads is that they be tight, and be kept so without an undue amount of work on them; this is particularly so in cases of high-pressure steam, as joints are much more apt to spring and leak under high pressure. In one instance to my knowledge the cylinder heads have to be packed (with Jenkins sheet packing or some similar material) every two weeks, and as there are two which require packing, the high pressure and intermediate cylinders, this is a costly operation.

The cylinder heads in this case were made with a very peculiar joint, which was designed especially for high steam, with what was called a "double rebate" joint, and which looked admirably adapted for the work—on paper. This is clearly shown in the fragmentary cut with this, and the two rebates or off-sets shown, one in each wall of the cylinder, as it was steam jacketed, the jacket being shown between the two walls. The head was fastened on by bolts or studs from each wall, they being spaced in a zigzag manner, as shown, the opening to the jacket being waved as shown. This double rebate was easy enough to make, in the drawing room, but not so easy to make in the shop, and, as a consequence, it was not a good joint of metal to begin with. It is not at all practical to make three surfaces fit, as is necessary in this case, and in order to have them fit as they should, it would take more time than the job should demand. But the job was not carefully done, and the joint was nowhere near tight when put metal to metal, and grinding was not tried, as it would take too long, so a packing was used, and would not last over two or three weeks. It was probably the idea of the designer that the steam would get tired before it had turned all the corners, but it didn't, and a leaky head was the result.

If I had been doing this job, or had been having it done for myself, I should have insisted on having nothing but a plain flat joint across both surfaces, and after having them faced off square and smooth should have had them ground to the head, or rather the head ground to them, then had the good metal surfaces drawn together by the studs. This will keep tight better than any packing, I am sure, and is a much easier job to do, only requiring care in facing off and grinding. There may be another cause for leakage than the fault of the joints (when they are tight when cold) and that is in the difference in expansion between the two walls of the cylinder, as the jacket chamber is kept at boiler pressure all the time, while the temperature of the cylinder varies with the cut-off, and in the case of the intermediate cylinder the difference in temperature will be quite marked. This might, to a great extent, be overcome by having the cylinder head, over the jacket space, made thin enough to give with the difference in expansion, so as to make the movement there instead of in the joints. This is shown in the next cut. Make the groove deep enough so as to leave sufficient metal to withstand the pressure of the jackets, but as it is less than the rest of the head it will give before the parts forming the joints move at all. Or we might make a groove in the face of each wall, and leave the head flat, and put a copper ring (endless, that is, ends joined) in the grooves, and bring the head down to it, making the joints on the copper rings.

These ought to afford the take-up for the difference in expansion by the expansion of the copper in the different places. A modification of this would be the grooving of the head, and the leaving of the walls plain, and this might be the cheaper way, or if thought necessary, both head and walls could be grooved; this, however, seems hardly necessary, and one groove will hold the wire from slipping, and the flat surface will make a good joint by compression on the copper. This will apply to jacketed or non-jacketed heads. But for either place the writer prefers the flat joint well made, and thinks it will give better satisfaction than any system of rebates or a multiplication of surfaces. If any one does not believe that it is difficult to make a joint as shown under the head of "double rebate," and have it tight under 150 pounds pressure per square inch, just let him try it, that's all. It may not be hard to get it to show a bearing after much careful work, but when this bearing will hold high-pressure steam, it must not only *show* a bearing, but it must *be a bearing* in reality.

Flat joints are hard to beat when nicely made, and they are the cheapest form of surface joint, although when there is a tendency to move sideways, as in some pipe lines, the rebate is of value, but not to form a part of the joint, merely to prevent side motion.

This is one of the many cases where a scheme which looks well on paper is not practical in the shop, and these mistakes might be avoided if there were more harmony between the two departments. It is a good plan in any shop to have a consultation between the drawing room and the shop management before launching any new scheme on the shop for manufacture, and

get the opinion of the shop men, whether the advice is followed or not. If the designer is a practical shop man, there is less need of this, although consultation is a good thing to preserve harmony. But if the shop management objects to anything and everything new, and the drawing room knows they are practical, the consultation will show the points which the shop objects to, and these can then be met by argument, or ignored, as the case may be. But the consultation plan is a good one for producing harmony, and preventing losses through impractical ideas being sent into the shop.

Fluxing of Iron in Cupolas.*

Flux is the term applied to a substance which imparts igneous fluidity to metals when in a molten state and has the power to separate metals contained in metallic ores from the non-metallic substances with which they are found in combination; also to separate from metals when in a fluid state any impurities they may contain. Fluxes are also used for the purpose of making a fluid slag in furnaces to absorb the non-metallic residue from metals or ores and ash of the fuel, and removing them from the furnace to prevent clogging and keep the furnace in good working order for a greater length of time. The materials used as fluxes for the various metals are numerous and varied in nature and composition, but we shall only consider those employed in the production of iron and the melting of iron for foundry work.

The substances employed for this purpose are numerous, but they consist principally of the carbonate of lime in its various forms, the principal one of which is limestone.

In the production of pig-iron from iron ore in the blast furnace, limestone is used for the twofold purpose of separating the iron from the ore and for liquefying and absorbing the non metallic residuum of the ore and ash of the fuel and carrying them out of the furnace. For this purpose large quantities of limestone are put into the furnace with the fuel and ore. The stone melts and produces a fluid slag, which absorbs the non-metallic residuum of the ore and ash of the fuel in its descent to the bottom of the furnace. Thence it is drawn out at the slag hole, and carries with it all those non-metallic substances which tend to clog and choke up the furnace. By this process of fluxing the furnace is kept in good smelting order for months and even years. Were it not for the free use of limestone, the furnace would clog up in a few days.

The blast furnace is a cupola furnace, and is constructed upon the same general principle as the foundry cupola. Foundrymen long ago conceived the idea of using limestone as a cupola flux. In many foundries it is the practice to use a few shovels or a few riddles of finely broken limestone in the cupola on the last charge of iron, or distributed through the heat a few handfuls to each charge of iron. The object in using limestone in this way is not to produce a slag to be drawn from the cupola, but to make a clean dump and a brittle slag or cinder in the cupola, that can be easily broken down and chipped from the lining when making up the cupola for a heat.

Limestone used in this way does not produce a sufficient quantity of slag to absorb the dirt from the iron and ash of the fuel and keep the cupola open and working free, but rather tends to cause bridging and reduce the melting capacity of the cupola.

The making of a brittle cinder in a cupola by the use of limestone depends to a great extent upon the quality of the stone. Some limestones have a great affinity for iron and combine with it freely when in a molten state, while others have but little affinity for iron and do not enter into combination with it at all. In the cinder piles about blast furnaces we find cinder almost as heavy and hard to break as iron, resisting the action of the atmosphere for years; while at others we find a brittle cinder that crumbles to pieces after a short exposure to the atmosphere, or even slacks down like quicklime when wet with water. In a cupola we may have a hard or brittle cinder produced by limestone. The results obtained from the use of limestone in small quantities in a cupola are so uncertain that I do not think they justify the foundryman in using it.

*Address by Dr. Edward Kirk delivered before the Philadelphia Foundrymen's Association.

LIMESTONE IN LARGE QUANTITIES.

The tendency of slag or cinder in a cupola is to chill and adhere to the lining just over the tuyeres and around the cupola at this point, and prevent the proper working of the furnace. So great is this tendency to bridge that a small cupola will not melt properly for more than two hours, and a large one more than three hours. To overcome this tendency to clog and bridge, foundrymen in many cases have adopted the blast furnace plan of using a large per cent. of limestone as a flux in their cupolas and tapping slag.

When a large per cent. of limestone is charged with the iron in a cupola, it melts when it settles to the melting point and forms a fluid slag. This slag settles through the stock to the bottom, and in its descent melts and absorbs the ash of the fuel and dirt or sand from the iron and carries them to the bottom of the cupola, where the slag and dirt it contains may be drawn off and the cupola kept in good melting order and in blast for days at a time. The amount of limestone required per ton of iron to produce a fluid slag depends upon the quality of the stone and the condition of the iron to be melted. It is the custom in some foundries, where the sprews and gates amount to from 30 to 40 per cent. of the heat, to melt them without milling to remove the sand, and to use enough limestone in the cupola to produce a sufficient quantity of slag to absorb and carry out of the cupola the sand adhering to them. In this case a larger per cent. of limestone is required than would be required if the sprews and gates were milled and only clean iron melted Poor fuel also requires a greater amount of slag to absorb the ash than good fuel, and a lean limestone must be used in larger quantities than a stone rich in lime. The quantity required to produce a fluid slag, therefore, varies with the quality of the limestone and the conditions under which it is used, and amounts to from 25 to 100 pounds per ton of iron melted.

The weight of the slag drawn from a cupola when the sprews and gates are not milled, and the cupola is kept in blast for a number of hours, is about one third greater than the weight of the limestone used. When the sprews and gates are milled, the weight of the slag is about equal to the weight of the limestone. When the cupola is only run for a short time and slag only drawn during the latter part of the heat, the weight of the slag is less than the weight of the limestone.

The slag drawn from a cupola has been found, by chemical analysis, to contain from 4 to 7 per cent. of combined iron and numerous small particles of shot iron mechanically locked up in the slag. These cannot be recovered except at a greater cost than the value of the metal. In a number of tests made in the same cupola, I found the loss of iron to be from 3 to 4 per cent. greater when the cupola was slagged.

EFFECT OF FLUX UPON IRON.

Many of the limestones and mineral substances employed as cupola fluxes contain more or less finely divided oxides, silicates, etc., in combination with earthy materials. The flux is often reduced in a cupola and its component parts separated and in minute quantities they alloy with the iron and injure its quality. The conjoined effect upon iron of these diffused oxides, silicates, etc., liberated in a cupola from their native elements in fluxes, is to prevent the metal running clean in the mold or making sharp, sound castings and the tensile and transverse strength is frequently impaired by them. When the oxides, silicates, etc., are not separated in the cupola from their native elements, they do not impair the quality of the metal, nor do they improve it. The tendency of the cupola furnace is to clog and bridge over the tuyeres, and concentrate the blast upon the iron through a small opening in the center and injure its quality. If by the free use of limestone we prevent bridging and keep the furnace working open and free we avoid injuring the iron in melting by the concentration of a strong blast upon it. The effect, therefore, of limestone in a cupola is not to improve the quality of iron but to prevent its deterioration in melting.

THE ACTION OF FLUXES ON LINING.

Limestone and other minerals employed as fluxes frequently contain impurities which enter into combination with the lining material of a furnace and render it fusible. This was illustrated at the foundry of John D Johnson & Co., Hainesport, N. J., a few weeks ago. The cupola front had been put in with new molding sand for a long time and no flux used in the cupola. The sand made an excellent front that resisted the action of the heat and molten iron upon it. As the heats enlarged, it became necessary to use flux and tap slag to run off the heat. Oyster shells were used and produced a slag that flowed freely and had no effect upon the sand in the front. When the supply of shells became exhausted, a limestone was used in place of them. Trouble then began with the front. It was melted by the flux into a thick, tough slag that settled down and closed up the tap hole and iron could only be drawn by cutting away a large portion of the front to enlarge the tap hole. Mr. Johnson called at my office to learn what could be done to keep the tap hole open. I advised that the front material be changed and a mixture of fire clay and sharp sand be used in place of molding sand. This was done and there was no further trouble in keeping the tap hole open and in good order to run off the heat. This serves to illustrate the effect of fluxes upon lining material. With no flux and with oyster shells the molding sand resisted the heat and pressure of molten iron and slag upon the front. But with limestone it melted into a thick, tough slag. This was due to some property in the limestone entering into combination with the sand and making it fusible. Had the cupola been lined with this molding sand, the entire lining would have been cut out in one heat, while it would have stood many heats with shells or no flux at all.

From the various qualities of cupola brick and lining material now in the market, a lining may be selected that will resist the action of almost any flux or slag, and foundrymen may select a flux to suit the lining or a lining to suit the flux, whichever they find to be the most profitable in their locality.

HOW TO SLAG A CUPOLA.

Foundrymen sometimes experience trouble in slagging their cupolas. This is largely due to a lack of knowledge in charging the limestone and drawing the slag, for any cupola can be slagged if properly worked. To draw slag from a cupola a sufficient quantity of limestone or other slag producing material must be charged in the cupola with the iron to make a fluid slag. The exact amount required can only be learned by experimenting with the fluxing material used, but it is generally from fifty to sixty pounds of good limestone per ton of iron, when the remelt is not milled. The limestone is generally charged on top of the iron and put in with each charge after the melter begins using it. No limestone is used with the iron on the bed or first few charges of iron. In small cupolas limestone is generally charged with the second or third charge of iron. In large cupolas, when the charges of iron are light, six or eight charges, or generally about one-sixth of the heat, are charged without limestone. This is the way limestone is used when the cupola is run in the ordinary way for a few hours. When the cupola is run for some special work, the limestone is charged in a number of different ways.

The slag is drawn from the cupola through an opening known as the slag hole This opening is made through the casing and lining under the lower level of the tuyeres and at a point in the cupola where it willl be out of the way in removing iron from the spout and convenient for removing the slag. The height the slag hole is placed above the sand bottom depends upon how the iron is drawn from the cupola. When it is desired to hold iron in a cupola until a sufficient quantity is melted to fill a large ladle, the slag hole is placed high, and when the iron is drawn as fast as melted the slag hole is placed low. When the slag hole is placed high, slag can only be drawn as the cupola fills up with iron and raises it to the slag hole. When the iron is withdrawn from the cupola, the slag falls and the slag hole is closed with a bod to prevent the escape of blast. When the iron is drawn from the cupola as fast as melted the slag hole is placed low and when opened it is permitted to remain open through the remainder of the heat. This is the best way of drawing slag from a cupola, for the flow is regulated by the amount of slag in the cupola, and if the hole is not made too large, there is no escape of blast.

The slag in the bottom of a cupola takes up impurities from the fuel and iron and if permitted to remain in the cupola for too long a time it may become so thick and mucky it will not flow from the slag hole. Or it may be filled with impurities, become over-heated, boil up and fill the tuyeres with slag; and when boiling, it will not flow from the cupola through a small slag hole. The time for drawing the slag from a cupola is therefore a matter of great importance. The slag hole is generally opened in from half an hour to an hour after the cupola begins to melt, and when placed low is permitted to remain open through the remainder of the heat. When placed so high that slag can only be drawn when the cupola fills up with molten iron, it should be opened as soon as the slag begins to rise and closed as soon as it falls below the opening.

DOES IT PAY TO SLAG A CUPOLA?

Nothing is gained by slagging a cupola when the sprews and gates are milled, and the heat can be melted successfully in the cupola without slagging, but a great saving in labor and wear and tear of machinery can be effected in many foundries by melting the sprews and gates with the sand on, and slagging to carry the sand out and keep the cupola working free. A cupola cannot be made to melt iron faster by slagging, but it can be kept in blast and in good melting condition for a greater length of time and a much larger amount of iron melted by slagging. Foundrymen who find their cupolas temporarily too small to melt the quantity of iron required for their work can overcome the difficulty by slagging the cupola and keeping it in blast for a greater length of time.

In endeavoring to make an estimate of the cost of slagging a cupola, I found that the cost of limestone in different localities varied from 50 cents to $3 per ton. The amount used varied from 25 to 100 pounds per ton of iron melted The amount of slag drawn varied from 25 to 100 pounds per ton of iron. The iron combined with the slag varied from 4 to 7 per cent. With these wide differences in the cost and quantity of limestone used, and the difference in the quantity of slag drawn and per cent. of iron it contained, I found it impossible to make an estimate that would be of any practical value to foundrymen. Such an estimate must be made at each foundry to be of any practical value.

SHELLS.

Oyster, clam and other shells are largely composed of lime, and are frequently used as a flux in place of limestone in localities where they can be procured at a less cost than limestone. The shells are charged in the same way as limestone, and in about the same proportion to the iron. They may be used in place of limestone either in large or

small quantities, and have about the same effect upon the iron and cupola as limestone. When used in large quantities, they produce a fluid slag that keeps the cupola working free, and flows freely from the slag hole, carrying with it the refuse of melting that clogs the cupola. When the heat first strikes shells in a cupola, they produce a crackling noise, and flakes of shell may be seen to pass up the stack, and the foundry roof, when flat, is often covered with flakes of shell after a heat, when shells are used in large quantities. The crackling is due to the destruction of the hard inner surface of the shell, the flakes thrown from the cupola are entirely of this surface, and the loss of shell is not as great as it would appear to be at first sight. The remainder of the shell melts, and forms a fluid slag that absorbs the refuse of melting, becomes thick, and helps to clog up a cupola when the shells are used in small quantities, or assists in keeping it open when used in large quantities.

MARBLE SPALLS.

Marble is another of the carbonates of lime, and the spalls or chippings from marble quarries or works are quite extensively used in some localities as a cupola flux. Their action in a cupola and effect upon iron is very similar to that of limestone, and they are used in the same way and in about the same proportions. There are a number of other substances, such as fluor-spar, feld-spar, quartz rock, and a number of chemical compounds that are used as cupola fluxes.

In 1873, when engaged in the manufacture of malleable iron, I began experimenting with mineral and chemical materials with the view of making a cheap malleable iron, and changing the nature of iron in a cupola furnace so that it might be annealed at a less cost, and produce a stronger iron. In this I succeeded to some extent, and then drifted off into improving the quality of iron in a cupola for gray iron castings; this I have followed for nearly twenty years. During this time I have melted iron in foundries all over the greater part of the United States and Canada, and have constructed and worked a number of experimental cupolas of my own, to learn the effect of different mineral and chemical substances upon iron and cupola linings. In these investigations I have used all the mineral and chemical fluxes known to metallurgical science, and observed their effect upon the various grades of iron employed for foundry work.

In these experiments I have found that iron can be improved or injured when melted in a cupola furnace, and is often ruined as a foundry iron by improper melting and fluxing. The point at which iron is melted in a cupola has a great deal to do with its quality. Iron melted too high in a cupola is burned and hardened; melted too low, it runs dirty in a mold; melted with too strong a blast, it is hardened. Iron melted dull does not make a sound casting. Iron melted with poor coal or coke is injured by the impurities in the fuel. Iron melted with oyster shells, limestone and other mineral fluxes may take up oxides, sulphides, phosphides, silicates and other impurities contained in the flux, and be ruined by them for foundry work.

The per cent. of iron lost in melting is increased by improper melting and fluxing, and may be double or treble what it should be. I have made a great many experiments to ascertain the effect of silicon on iron, and have found that silicon enters freely into combination with cast-iron, and has a softening effect upon it. Iron as hard as tempered steel may be made as soft as lead by combining it with silicon. But silicon is an impurity having a deleterious effect upon iron. An excess of silicon destroys cohesive force and crystallization, and reduces transverse and tensile strength. So great is the destruction of cohesive force in cast iron by silicon that the strongest iron may be reduced to a powder when combined with an excess of silicon. Silicon in any proportion is a detriment to cast-iron, as an iron. The nature and form of crystallization of a pure cast-iron is changed by sudden cooling in a mold, and a soft iron in the pig may become a hard iron in a casting. This chilling property in cast-iron is destroyed by silicon, and an iron high in silicon is not hardened when run into a sand mold or upon an iron chill. The destruction of the chilling tendency in cast-iron is very desirable in the manufacture of light castings, and for this reason silicon irons are largely used in foundries making this class of work.

The per cent. of silicon an iron may contain, and yet retain sufficient cohesive force for the work, depends upon the amount of other impurities in the iron, and the work the iron is employed to make. For heavy work, requiring great strength, it should contain none at all. For light machinery it may contain from one-half to one per cent., and for stove plate, light bench work, etc., it may contain from two to three per cent. This amount is sufficient to reduce the chilling tendency of the iron without impairing its strength to any great extent in this class of work. But a larger amount destroys the strength of the iron, and also injures its flowing property in a mold.

At the present time there is a large amount of high silicon cheap Southern iron being used in stove foundries for the purpose of making a cheap mixture and a soft casting. At one of these foundries I recently visited, the foreman informed me that they were using a mixture that cost $14 per ton, and said their breakage in the tumbling barrels and mounting shop was very large, and he never made a shipment to their warehouse in New York, a distance of 25 miles, but a lot of stoves were broken in transit and sent back to be remounted and repaired.

At another stove foundry in Troy, N. Y, they informed me they were using a mixture of Pennsylvania irons that cost them $20 per ton. They had scarcely any breakage at their works, and shipped their lightest stoves and plate to their warehouse in Chicago, without boxing or crating, and never had any breakage in transit or in handling. They had found by experience that a mixture of Pennsylvania irons at a cost of $20 per ton was cheaper in the long run than a mixture of cheap Southern irons at $14 per ton.

In a number of other foundries I visited they all complained of heavy breakage when using high silicon irons as softeners. Another matter to be considered in using these high silicon irons for stove plate, is, how long will a stove last made of such weak iron, and can a reputation for good work be maintained by foundries using them? A stove made of this kind of iron will certainly not last as long as one made of good iron.

Carbon has the same effect upon cast-iron as silicon, in softening and reducing the chilling tendency. The hardest of cast iron can be made the softest by the addition of carbon without destroying its cohesive force, and rendering it brittle or rotten, and carbon can be added to iron in a cupola as readily as silicon. Before the high silicon Southern irons were put upon the Northern market, highly carbonized irons were used as softeners for stove plate and other light work, and a far better grade of castings were made then than is now made from the silicon irons.

It is difficult to remove silicon from iron when melted in a cupola, but free carbon is readily removed by the oxidizing flame in a cupola produced by a strong and large volume of blast; and a soft iron may be hardened in melting to such an extent as to make it unfit for the work. This can be prevented to some extent by using a mild blast, and melting the iron low in the cupola, and it can also be prevented by the use of chemicals in the cupola to produce a carbonizing flame.

I have spent a great deal of time and money in experimenting on the production of such a flame in a cupola, as would not only prevent the deterioration of iron in melting, but would improve its quality, and at the present time I am engaged in the manufacture of a chemical compound for this purpose.

LETTERS FROM PRACTICAL MEN.

Milling Machine Feeds.

Editor American Machinist:

It pleases me greatly to see the articles in your paper regarding the running of milling cutters in relation to feed.

Permit me to say that the proper method is to run the work with the cutter when possible.

In running the work against the cutter, not only does the cut start at nothing and grow heavier, but the action of an "axial mill," especially in heavy work, is to clog the teeth with chips, thus bringing a strain on the machine that increases rapidly in proportion to feed; also the necessity in most cases of securely fastening the work to the platen.

In feeding the work with the cutter those faults are largely overcome, and it has been my experience that more work could be done at a cutter speed of about forty feet per minute, three to six-inch feed, with less power and cutter wear, than was possible with work running in opposite direction.

Have experienced very little trouble from backlash, and think that if the machine is a product of a reliable maker, properly taken care of, there will be little difficulty experienced in that direction.

We have some machines that have been in comparatively hard service for the past six years, and thus far the most trouble we have experienced has been in educating the workmen to bring the work to the cutter carefully, starting the feed just before cutting.

I can recall but few cases of ruined cutters that were not caused either through lack of judgment or carelessness on the part of the operatives.

Mr. Beach's experience recalls a case in which I was "mixed up" that may interest some of your readers:

We had to cut up a number of finished bars of low moor iron three-quarters of an inch square by three feet, into pieces five inches long. On previous occasions those pieces were held in the milling machine vise, four at the time, fed against the saw about one and one-quarter inches per minute (cutter 4″ diameter $\frac{1}{16}$″ thick), speed of ninety revolutions, with about the same experience as Mr. Beach.

Things have changed; we now have a backing piece fitted to cross-slot near one end of platen; the bars are simply laid across platen, twenty at a time, and forced against the backing piece (sufficient to hold them and not spring the platen), with wedges and a block fitted to the slot at other end of platen.

When cutting we use two saws placed the requisite distance apart, running on to the work, cutting up a lot of three hundred bars without breaking or even grinding the saws. The feed was all that we could get, *i. e.*, two and one-half inches per minute, with cutter speed of ninety revolutions.

I found later that a three and one-half inch feed might have been used without danger.

I desire to call attention to the deficiency in proportion of feed to cutter speed on some machines. The performance of the above machine (comparatively new, and the product of one of our leading makers), demonstrates to us that the cutter speed was excessive in order to get a feed that was unquestionably slow for a "back-geared" machine. In your issue of the 9th inst., Mr. J. A. McGregor writes: "The article by 'Mechanic' is quite true," and further, "by the old way of running cutters the platen is picked up and dropped hundreds of times." Now my understanding of "Mechanic's" article, which I find verified in practice, is that with an ordinary chip, say three-sixteenths deep, the action of an axial cutter three inches diameter (especially if cut spiral) is to ride, or cause a downward pressure, after the cutter gets well on to the work. This can be plainly observed if work is mounted on centers, and fed the old way.

J. M. LYNCH.

F t = m v—Cam Rollers—Milling Machine Feeds.

Editor American Machinist:

In the October 5, 1893, issue of the AMERICAN MACHINIST, Mr. C. H. Campbell scornfully asks, "Who is 'Easy Way,' anyway?" I refused to answer this question when propounded by Oberlin Smith, but to avoid further consideration of an unimportant matter I will here state that I am "Easy Way," B. A.,—Blastodermic Atom—in process of translation from nothing to nowhere. Also P. P.—Protoplasmic Particle—journeying from chaos to oblivion. Professionally I am a tangler and untangler of motions. I reside at times in a cave of gloom; that is, when the motions don't tangle and untangle to suit me; at other times I abide upon a lofty pinnacle of serene effulgence; that is where I am living at present, because I have just made an application of the epicyclic crank which greatly pleases me, as Professor Meyer and Mr. Miller well know. Having thus fully, particularly and categorically disclosed my origin, my titles, my occupation, and my places of abode, I trust no one will again waste space in the AMERICAN MACHINIST by foolish questions as to my personality.

Mr. Campbell also asks if I would construct a cam face to act on a point, and afterward put a roller in place of said point? I would not construct a cam face to act on a point. I am sure of that. If Mr. Campbell means to ask if I would determine the *path* of a point, and then, in order to constrain a moving mechanism to follow the path of that point, draw sundry equal circles having their centers in that path, these circles representing a roller in different positions, and then draw a curve tangent to these roller circles to determine the outline of a cam to give the motion I desired, I would reply that I have often done so. And I would further say that I always noticed that the *smaller I made the roller circle* the more the cam face looked as if it would stay with me a little while. Has Mr. Campbell never observed the same remarkable coincidence? If not, he never laid out a cam in his life. Mr. Campbell unfortunately views a cam roller as a modified cart wheel, which it *is*, driven from its axle, which it is *not*.

Both Fig. 2 and my reasoning in the AMERICAN MACHINIST of June 20 are (except as subsequently corrected) precisely right in every way, and my conclusion that "the diameter of the cam roller and *no* other dimension determines the possible speed of a cam action with a given cam," is indisputably correct.

Presumably Mr. Campbell knows the meaning of the hieroglyph which forms the title of this article. Mr. Oberlin Smith certainly does know what it means, and hence made no reply to my assertion that the cam roll should in all cases be made as small as possible. Indeed, the proposition is self-evident, and only for the young designer would I notice what Mr. Campbell says. I again repeat the axiom, "The smaller the cam roll the greater the time of acceleration with a given cam." But why waste words? Mr. Campbell evidently ignores acceleration, in which happy carelessness Mr. Campbell differs wholly from machines—*they* remember acceleration all the time, and have gloomy and discouraging ways of expressing their objections when they don't have sufficient time for it.

Like Mr. Campbell, I have the highest respect for the rule of thumb. It is a part of my creed that no book man ever did a new thing, and I can tell plenty of amusing tales of men who did things the book-men said never could be done, and of how the book-men even denied the things were done when they first saw them done. But I am forced to reluctantly admit that the book-men really are, at times, wise *after* the fact. There is a charming little book written by one Kennedy, which I hope Mr. Campbell will never read for fear it might make him tired of himself; that book says on p. 253, "It is clear that any quantity of work however great can be done by any force however small if it only act over a sufficiently

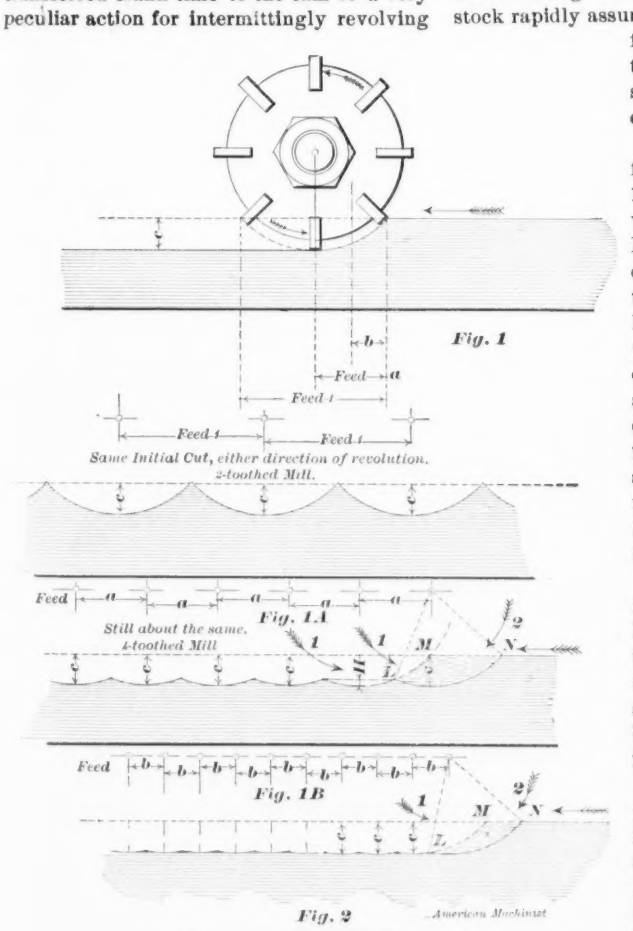
great distance. The mere measurement of work in foot-pounds would not, therefore, afford us any means of comparing the apparatus by which the work was done. For that purpose we compare, not the absolute quantities of work done, but the *rate at which the work has been done;* that is, the number of foot-pounds of work done in a unit of time." On p. 225, "This holds good always; every shortening of the *time* of an operation is accompanied by an exactly proportionate increase of the *force* necessary to carry it out."

How wearisome this kindergarten work is. Don't you know yourself, Mr. Campbell, that the quicker you do a thing the harder it is to do it? Very well, then; the larger you make your cam roll the less time you have, with a given cam, to do your work in, and that settles it, don't it? And let the unlucky young cam designer remember this—make the cam roller stud as small as strength will allow, and the cam roller a mere shell to obtain the smallest possible cam roll and the greatest possible time for acceleration; make your cam roller stud as large as you can, so as to have a good wearing surface, and your cam roller as thick and large as you can, so as to get as far away from a line contact of cam and roller as you can and have as much leverage as possible to make the roller turn on the stud. Put your elbows on the drawing board and take your head in both hands and consider well how far Peter shall be paid by robbing Paul; and when your cam action, as you finally make it, runs like a lumber wagon on a corduroy road or won't run at all, just make it over again until it will run; that's the way everybody does with cam actions, if they are quick.

Thanks are due to Mr. C. L. Redfield for his diagram for laying out a cam rise with crank time on p. 9 of the October 5th AMERICAN MACHINIST. Francis Richards, at the Pratt & Whitney shops, put a crank actuated mechanism on a gear cutter which transferred crank time to the cam of a very peculiar action for intermittingly revolving the table of an envelope machine, thus doing mechanically what Mr. Redfield shows how to lay down on the drawing board. I have never seen the diagram before. The young cam maker will be the gainer by fixing this cam form in his mind, and the diagram in his memory.

Isn't it queer? Mr. Fred H. Colvin, of Worcester, Mass., that home of so many fine mechanics and so much elegant detail invention, says he has been "West," and was surprised to learn that possibly work should be fed to a mill *with* the direction of mill revolution instead of *against* the mill revolution. Mr. Colvin says, "Of course for work having a scale on it, such as a casting or forging, the only way to do is to feed up against the mill, so that the mill may come up against the scale," the idea being to *break* the scale away instead of dulling the cutters by bringing the teeth down on the scale. Mr. Colvin would have been surprised had he stopped at Hartford on his way "West" to see large milling machine cutters working down on the scale of rough castings for the sole purpose of making the cutters last. Incidentally, of course, feeding with the cut takes all the hard labor off the feed works of the milling machine, as the carriage, far from having to be forced to the work, has to be strongly held back, and the feed works simply let the cutters drag the piece into the machine. In Fig. 1 it is clear that the thickness of the cut is infinitely small at the beginning of the cut made by any one tooth, and gradually increases as the cut proceeds. As the cut is infinitely thin where it should begin, the pressure of the cutter on the metal at this point is infinitely small, and as it requires a very great pressure to make a mill tooth cut metal, the cut does not begin where it should; the tooth slides over the smooth surface of the metal hill in front of it until sufficient pressure is established to force the mill tooth to bite the metal; then the cut begins with a jump of the tooth into its work, and leaves a ridge where it began, and the preliminary rubbing of the tooth on the work, while establishing the pressure needed to start the cut, dulls the cutter much more than the actual work of cutting the chip dulls it.

It is, of course, impossible to cut an engraving to show the real shape of the cut of a mill with the ordinary feed of say one to three-thousandths of an inch feed per tooth. But by inductive stages it is conclusively shown in Figs. 1*A*, 1*B*, and Fig. 2, that the stock rapidly assumes an unfavorable form for the initial action of the cutter tooth on the stock as the feed decreases.



MILLING MACHINE FEED.

Suppose an intermitting feed, the length of feed 1, Fig. 1. The cuts would then show as in Fig. 1*A*, same cut either direction of mill revolution. Fig 1*B* the feed is halved to feed "*a*," and the form of stock still opposes the cutter with about equal cut starting efficiency in either direction of mill rotation, as shown by inspection of the dotted radial lines and the section *L M N* of chip next to be cut.

But in Fig. 2 with per tooth feed equal to "*b*," Fig. 1, it is at once seen that the cutter is much more liable to slip on the stock if the tooth moves bottom to right than if it moves bottom to left.

Fig. 2 at once suggests this conclusion: The smaller the mill diameter and the coarser the feed, the longer the life of the individual tooth in inches of cut made, which is undoubtedly correct.

Fig. 2 shows that when the work is fed with the mill, the cut begins as soon as the tooth strikes the metal, if the tooth don't come off, and the thickness of the chip constantly decreases from *M* as the cut proceeds. Fig. 2 also shows that such a mill cut is not a cut, but a crush or a cleavage, and probably the virtual cutter is not the tooth of the mill, but a wedge of the milled metal forced downward and forward by the cutter tooth, which simply lies against the first touched surface. I do not mean that one wedge of the material splits the entire chip off the mass, but that the operation of cutting a chip is effected by the formation and driving of a series of such wedges during the cutting of one chip. However this may be, the fact remains that the old must-be-so direction of mill feed is now in many cases of heavy cast-iron milling reversed in late practice to the great saving of cutters. Milling has not reached its final form, nor its greatest efficiency. But once more, how odd, seeing that Hartford and Worcester are so near together!

EASY WAY.

Setting a Bevel at Forty-Five Degrees —A Filing Device.

Editor American Machinist:

Forty-five degrees is an angle very commonly used. I have a quick way of setting a bevel for that angle which may be new to some. The end of the bevel blade is usually at some other angle than a right angle, so I file mine so by using a square it is set at 45 degrees as shown in Fig. 1.

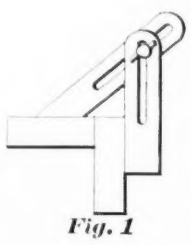


Fig. 1

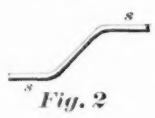


Fig. 2

Another idea for files when you have an awkward place to file out and have not a riffler or bent file suitable. Take a piece of wire sufficiently stout and long enough, bend it to the correct shape (Fig. 2 for instance) flat the under-sides at *s s*, take a file of the size and shape you require, break it up into pieces of the right size, grind one side flat and smooth, and solder them to the flat places *s s* on wire—this makes a durable and cheap tool. Files may be warmed to the melting point of half and half solder without starting their temper. You have a better and handier tool than if you should heat the file, bend it and reharden it. Almost any shape handle can be put on a piece of a file in this way, or on a whole file, and will help out an awkward job—always tin each surface before soldering.

MACHINIST.

The Value of a Caveat.

Editor American Machinist:

I chanced to-day to look over your issue of October 12th, and noticed answer to J. S. W. advised him that a caveat filed in the Patent Office will afford him temporary protection. This is a mistake, it only affords remote protection in cases where the matter in hand will be in an experimental stage for a long time.

The only excuse for referring to this is in the fact that large values are locked up in inventions of apparently small importance, and a mistake as to rights or proceedings often jeopardizes and sometimes causes loss of an inventor's rights.

A caveat is merely a notice to the Commissioner of Patents that the caveator has conceived an invention so and so, and is *endeavoring to perfect it.* He also describes the thing as far as he has progressed with it, and indicates what he *expects to accomplish.*

The effect of this notice is simply to prevent the issue of a patent to another inventor for the invention disclosed in the caveat without the caveator being informed of it.

It has no reference to an invention already completed, and the policy of the law does not favor the withholding of an application for a patent under cover of a caveat.

The proper course with a completed invention is to apply for a patent.

R. D. O. SMITH.

A Valuable Suggestion.

Editor American Machinist:

Here is a mighty valuable shop kink: In filing band saws, tie a string where you begin to file, and then you can tell when you get around, and therefore all the teeth will be sharp, and you will not file any of them twice.

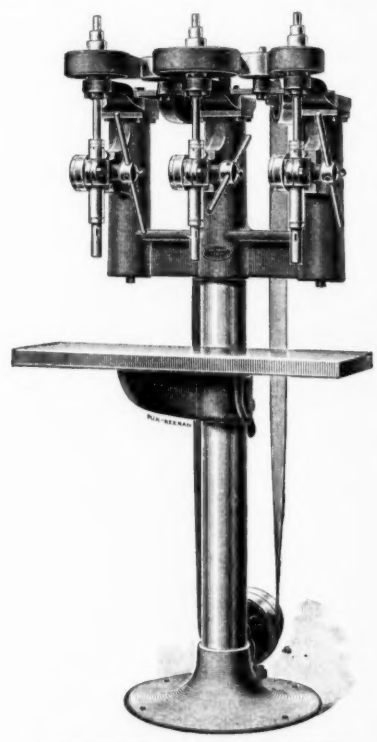
This kink was given me by a man that files band saws right along. GREASER.

[Not a very large proportion of our readers file band saws, though some of them do, and to these the above kink will of course be valuable. But it is readily apparent that the principle may be carried out in sharpening other kinds of tools. For instance, it is a common thing for machinists to take as many as half a dozen or more lathe or planer tools to the grindstone at one time, and by applying this principle, and tying a string around each tool as he grinds it, one can tell which ones have been ground, and which have not, and thus none will be left unground, nor will any be ground twice—unless a string gets lost. "Greaser" demands $1,000 for this saw filing kink, but as he files no saws, and we have shown him how he can apply the principle to something that he does do, we shall call it square, and refuse to send him the money.—ED.]

Three-spindle Drill Press.

We have previously illustrated and described a light drill press, made by the Geo. Burnham Co., 15 Hermon street, Worcester, Mass., and we now illustrate a three-spindle drill made by the same company, and retaining many of the distinctive features.

In this machine the three spindles are driven by an endless belt, means being provided whereby the tension of this belt may be readily adjusted.



THREE-SPINDLE DRILL PRESS.

The sizes of the spindle pulleys are 4½″, 6″ and 8″, giving, with the three steps of the cone pulleys, nine different speeds at which drills and other tools can be driven. The two outside spindles will drill in the center of a 22″ circle. The spindles are 10″ apart. The table, which is 12″x32″, is counterbalanced by a weight inside the column. The machine weighs about 600 pounds.

The annual report of the Commissioner of Patents shows that the number of patents granted during the fiscal year, including reissues, was 23,471. The number of expiring patents was 13,672. The total receipts for the year were $1,288,809, and the expenditures $1,111,444. The increase in receipts over the previous year was $20,082, and the decrease in expenditures of $2,690. The balance in the Treasury to the credit of the Patent Office, $4,279,805.

Railroad and express companies are working to the end of securing a national law punishing attempts at train robbing by 20 years' imprisonment. There ought to be no opposition to such a law.

The New York Board of Fire Underwriters ask that a law be passed requiring those who do electric light wiring to pass an examination and secure a license.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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$4.00 a year to Other Countries, postage prepaid.

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"Business Specials," 50c. a line.

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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, NOVEMBER 30, 1893.

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Labor Statistics.

Hon. Carroll D. Wright, in the course of an interesting article published in the November number of *The Engineering Magazine* on "The Value and Influence of Labor Statistics," gives an instance of such value in connection with the Massachusetts ten-hour law, passed in 1874—the first ten hour law passed in this country. The statistics published by the bureau of the State did much to help the passage of the law and afterwards prevented its repeal, manufacturers claiming that, brought under the operation of this law so far as minors and women were concerned, they were at a disadvantage in competition with manufacturers of other States; "so the Legislature directed the Bureau of Statistics to investigate the subject of the hours of labor in that State and in other New England States. The result of the investigation showed that, working under a ten hour system, the Massachusetts manufacturers paid more wages than those of other States, where 11 and 12 hours were the rule; that they produced more goods on any basis that could be named, whether individually or per machine, and that in every respect the Massachusetts operatives were under better conditions than those of surrounding States. There has been no attempt since that report was published to repeal the ten hour law of Massachusetts. On the other hand, other States have followed suit, until now that system prevails almost generally in the United States." The facts as stated undoubtedly sustain Mr. Wright's position as to the utility of labor statistics, though we think the inference drawn from it is not absolutely conclusive as to the economic value of the ten hour system, for the reason that other causes that may also contribute to the superiority of Massachusetts' industrial operations are not excluded or shown to have no bearing upon the result. It is our belief that, other things equal, and, generally speaking, the most intelligent, the best circumstanced and the highest paid labor is most efficient, and produces goods at the lowest cost per yard, per pound, or per piece. This opinion is borne out by abundance of facts and may account in some measure for the greater efficiency of Massachusetts manufactories at the time Mr. Wright's report was made, though there is, of course, no positive or affirmative proof of this. It seems, however, probable that the general enlightenment, public spirit, and ambition of Massachusetts operatives that led to that State being the first to enact a ten hour law also led to its factories being most efficient per employe and per machine. Of course, this is by no means saying that a ten-hour day is not better than a longer one in every way, for we think it is; and moreover, that in many employments less than ten hours are superior to ten hours or over, economically considered and without reference to the other and perhaps more important phases of the question.

Another instance of the value of statistics is given by Mr. Wright in the matter of savings bank statistics, his investigations in Massachusetts having shown that only about one-half of the savings bank deposits in that State belonged to persons engaged in manual labor, thus throwing light upon some arguments based upon the assumption that savings-bank deposits are necessarily conclusive as to the relative condition of manual workers in different sections or countries more than they are of other classes of communities.

We believe Mr. Wright is an able and honest statistician, and that his statistics increase the world's stock of reliable knowledge relating to important matters.

A Flying Machine to Boom Lots.

The baldest case of coupling a real estate speculation with a chimerical mechanical invention that has come to our notice recently occurs near this city, the advertisements as published in at least one of the city papers giving a cut of an air ship supposed to be on its way to Europe, the time being given as 24 hours. This air ship is to be built entirely of steel 774 feet long, 144 feet diameter, and is to be completed within 18 months at a village in which there are many vacant lots. Consequently and therefore the trusting public ought to step up and buy these lots "on favorable terms." As a further reason why these lots should be purchased it is stated that the cylinder of this air ship will be air tight and that the air will be pumped out of it, and below this cylinder will be rigidly suspended a three-story steel car 425 feet long. Darius Green with his flying machine missed a golden opportunity. He should have bought a tract of improved land and sold it out in building lots while constructing his machine, but it seems not improbable that those who may find it possible to buy lots will have to subscribe to mechanical journals that make a practice of exposing the fallacies of the various manufacturing schemes that are to boom corner lots.

The "Columbia."

The recent performance of the new U. S. cruiser "Columbia" must be especially gratifying to Chief Engineer, Commodore Melville, at whose instance the triple screw design was decided upon; the speed of the vessel for the average of the entire run being about 22 81 knots, while it is claimed that spurts of speed occurred during the run which were at the rate of 25 3 knots; which, it is believed, puts the "Columbia" at the head of the cruisers of the world for speed. This, of course, is due rather to her high power in proportion to displacement than to the fact that this power is exerted upon three screws instead of two or one, the advantage of the three screw system so far as effect upon speed with a given power is concerned consisting, if it exist at all, in the better submersion, due to the fact that the screws can be smaller in diameter.

The advantages of the three screw system for war vessels consist mainly in the fact that it permits greater power to be used with a given draught and displacement, permits in cruising the use of one, two, or all three engines, according to the rate of speed desired instead of sacrificing economy by slow engine speed, and finally gives greater security against total disablement during an engagement; any two or even any one of the engines being sufficient to keep her from being totally helpless in case of accident to the others. It is thought that the Cramps' premium upon this vessel, earned by her excess speed over the contract requirements, will figure up to the very comfortable sum of about $350,000. According to published reports there was some trouble from water in one of the engines, so much so that it had to be slowed down twice during the run, but upon the whole the machinery seems to have done its work admirably, and, what is of great importance, to have been in excellent shape at the close of the trial.

A Good Time to Buy.

The fact that one or two concerns in the country can make and sell steel rails at a good profit at a price at which the other manufacturers cannot pay expenses is a significant one. It shows that these concerns have supplied their plants with the best modern machinery for making rails, and it follows as a consequence that the other manufacturers must do the same or quit the business. And what is true in this respect of the manufacturers of steel rails is true of every other kind of manufacture—and business of every kind as to that.

When in any kind of manufacture there is not business enough to go around, those that—quality being the same—are in possession of plants best adapted to their purposes will get the work, because they can afford to do it for the least money. In the machine business, for example, shops trying to get along with obsolete tools are likely to be in trouble, for the next year or two at least. In rushing times such shops may manage to live, while well-equipped shops grow rich, but in dull times, or in moderately good times, they cannot hold their own. This is growing to be more and more so year by year.

Fortunately for those wanting or needing machine tools—if not for those who make them—they can be bought cheap, and never of so good quality. Manufacturers of machine tools fully understand the necessity of keeping up the standard of excellence in dull times, and in whatever way they may try to reduce cost it will not be by the use of poor materials or by inferior workmanship. They may be depended upon not to do anything so foolish as this. While they may hardly intend to put better workmanship on their products the determination to keep straight is almost certain to result in a little unconscious leaning backward; the pains taken to the end of certainty in doing as good work as ever is very apt to bring about a little better work.

It is a good time to put machine shops in order for more business, and those who judiciously place orders for machine tools now can do so with the certainty of getting a good deal for their money.

Grammatical and Other Blunders.

A grammatical purist writes to the *Evening Post* of this city and incloses a copy of a testimonial issued from the School of Mechanical Engineering and of the Mechanic Arts at Cornell University. This testimonial is signed by Professors R. H. Thurston and J. L. Morris, and contains what may properly be termed an error in grammatical construction, nothing which anybody is justified in making a fuss about, and yet this is published in the paper mentioned with the evident intention of holding up to ridicule such a man as Professor Thurston, who, as everybody knows, not only can and does write pure English, but possesses a fund of knowledge and information much beyond that required for merely pure diction, and has made a name for himself far greater than any one we ever heard of being connected with the *Post*, except Bryant. The *Post* seems to have a special spite at Cornell University because there was established there a so-called "School of Journalism," something which the *Post* contended was absurd since journalism could not be taught in a school. During the "Q" strike the *Post* said that if the men were not careful how they discommoded the public, the people would "demand" that schools be established in which men should be taught to run locomotives; a school and a branch of school teaching so much more absurdly impossible than one in which journalism should be taught that they are not, as horsemen say, in the same class, and we have no doubt the *Post* still thinks men can within a few months' time be taught in a school how to run locomotives. It is so much easier to see and to carp at the mistakes of others than to perceive our own absurdity. To be able to write absolutely pure English and to always write it absolutely pure is no doubt a very desirable attainment, but it ought to be recognized that some very admirable people do sometimes write English that can be improved upon, and that upon the other hand some who always write pure English know how to do little else.

The great coal strike in England has been settled, the men gaining their point in so far as preventing the proposed reduction of wages, there being, of course, the less justification for the proposed reduction since the strike has raised prices of coal to fabulous figures. One result of the long struggle has been the serious crippling of many of England's most important industries aside from the mining and transportation of coal, and the great disturbance and suffering entailed have given considerable impetus to the idea of government control of coal mines, which are in England even more than in this country, if such a thing is possible, an absolute essential to industrial operations.

It is understood that orders have been issued from Washington to defer the collection of the 10 per cent. tax on pay checks

issued by Hartford manufacturers during the extreme scarcity of currency last August. Though a strict interpretation of the law seems to require the collection of this tax, this order to defer taking steps in that direction probably is the last of it, as it ought to be.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(576) W. E. W., Pittsburgh, Pa., writes: Kindly let me know which side of a leather belt should go next to the pulley. *A.*—The grain or smooth side of the belt should be next to the pulley. The belt, as well as the pulley, adheres best when smooth, and the grain side adheres best because it is smoothest.

(577) A. J. W., Las Cruces, N. M., writes: A man lifted three hundred pounds, and in doing so injured his back What caused the injury, an improper *stress* or an improper *strain?* *A.*—From a mechanical standpoint, *stress* is distributed force and tends to change the shape of a body; *strain* is the amount of change of the shape of the body caused by the applied stress. We should therefore say that the man injured or *strained* his back caused by an excessive *stress*.

(578) W. H. M., Wilbraham, Mass., writes: Please inform me how to temper mill picks such as are used for dressing stone. *A.*—Heat the end of the pick which is to be hardened to a cherry red, preferably over a coke or charcoal fire, plunge the point in cold water, and then let the temper run to a hardness found by experience to be suitable for the work, probably a temper run to a dark straw color will be satisfactory. Care should be taken to have heat enough in the pick after plunging the point into the water to run the temper down to the required hardness. 2. Is there any liquid superior to water for the purpose? *A.*—In our opinion water will give as good results as any mixture.

(579) J. H. J., Central Falls, R. I., writes: Kindly publish the name of some liquid used in the manufacture of ice, or for cooling purposes. *A.*—Mechanical refrigeration of to day is produced by the evaporation of a volatile liquid whose boiling point is at least below zero; the lower the better adapted for the purpose, provided the liquid has large capacity for storing and carrying away heat during evaporation. The liquid in most extensive use is anhydrous ammonia, whose boiling point is about $28\frac{8}{10}$ degrees Fahr. below zero. The underlying principles and the prevailing practice of refrigerating engineers are given in articles treating on mechanical refrigeration and ice making in our issues of June 26, July 10, and August 14, 1890.

(580) "Machinist," Hartford, Conn., asks: Can you tell me the angle of the flat head wood screw, and also if the machine screw of that head is the same angle? Is there a table for standard thickness or depth of head and diameter at top? *A.*—We have given in issues of July 28 and September 8, 1892, all the information that seems readily obtainable on this subject. 2. Also how to find the diameter of a hexagon across corners when the distance from side to side is known. For instance, I wish to mill a hexagonal nut $1\frac{1}{4}$" from side to side, how large must the blank be turned to mill to those dimensions and leave sharp corners? *A.*—Multiply the distances over the flat sides by 1.155. In the case mentioned, the size will be $1.75'' \times 1.155 = 2.021''$.

(581) J. H., Windsor, Ont., writes: Owing to a difference of opinion existing between a friend of mine and myself regarding the indicated horse-power of the U. S. cruiser "Detroit," please give indicated horse-power as accepted on the trial trip. My friend claims that the "Detroit" has engines of 30,000 indicated horse power. *A.*—The aggregate I. H. P. of both main engines on the "Detroit" is 5,154 27; the total maximum I. H. P. of all the machinery is 5,435 94. 2. Does the United States own a vessel of 30,000 I. H. P.? *A.*—No. The "Columbia" on a recent trial trip is reported as having developed 22,000 I. H. P., but this is not an official report, as there has not been sufficient time for its preparation. However this is the highest-powered vessel in the U. S. Navy.

(582) C. J., Cincinnati, O., writes: I would like you to inform me how to find the diameter of a new gear under the following condition: I want to cut an 18 thread on an old lathe, for which I need a gear with 108 teeth. Now what should be the outside diameter of this gear to mesh with one $8\frac{1}{16}$ inch outside diameter having 96 teeth? I cannot find the pitch diameter. *A.*—In a case of this kind you need not pay any attention to the pitch diameter. The outside diameter of the gear with 108 teeth is found by the simple rule of proportion, namely, as 96 teeth are to 108 teeth, so is $8\frac{1}{16}$ inches to the required diameter. From the foregoing we get:

$$\frac{108 \times 8\frac{1}{16}}{96} = 9.07$$

for the diameter of the gear blank. This method gives an approximate result, but sufficiently close in this case.

(583) B., Ravenna, O., writes: Suppose I have a hoisting drum driven by a friction clutch, the drum and clutch being on the same shaft which makes 100 revolutions per minute, and the drum lifts a load of one ton; if now I increase the speed of the shaft to 200 revolutions per minute, will the same clutch do its work under the changed conditions? *A.*—On general principles the clutch must be designed for the work a machine has to perform. It is reasonable to assume that in your case, the speed of 200 revolutions per minute must be reached in the same time that a speed of 100 revolutions is reached; under these conditions the clutch for the high speed must be twice as strong as that for the slow speed, friction being neglected. It is however quite possible that your clutch is more than strong enough for the slow speed, so that it may be used for increased speed. After a uniform speed has been obtained, the clutch originally designed for the slow speed will be strong enough for the high speed.

(584) F. D. S., Wilmington, Del., writes: Please give me a rule for finding the pressure exerted by the ram of an hydraulic press; the lever is 24 inches long, weight on lever 150 pounds, radius of pitch circle of pinion $1\frac{1}{4}$ inches, pump plunger 1 inch diameter, ram $3\frac{1}{4}$ inches diameter. *A.*—From the above description we understand the hydraulic press to be similar in construction to that shown in answer to Question 233 in our issue of May 11th, current volume. Under these conditions we use the same formula as given in the answer referred to, namely:

$$W = \frac{D^2}{d^2} \times \frac{P \times L}{l},$$

in which W denotes the pressure in pounds exerted by the ram, D the diameter in inches of the ram, d the diameter in inches of the plunger, P the force in pounds applied to the end of the lever, L the distance from the center of the pinion to the point of application of the force, and l the radius of the pitch circle of the pinion. Assuming that the length of lever as given by you means the distance from the center of pinion to the point of application of the force P, we have, by substituting for the symbols their values,

$$W = \frac{3.25^2}{1^2} \times \frac{150 \times 24}{1.25} = 30,420 \text{ pounds.}$$

(585) J. M., New York, writes: Please inform me by which means the original drawing of the illustration of the "Bessemer Blowing Engine," published in your issue of October 26th, current volume, was prepared I wish to ascertain this on account of the very exact and fine finish of the lines. *A.*—We did not see the original drawing. But the cut has evidently been made by the wax process For this process a copper plate is covered with a thin coating of wax, and the lines are then engraved on this wax surface deep enough to expose the copper surface. The manipulation of tools for engraving the machine or design is very similar to the manipulation of drawing instruments; in fact, the principal difference is, that in one case the object is drawn on wax, and in the other case the object is drawn on paper. After the engraving is finished an electrotype is taken from it, and this electrotype is used for printing. From the foregoing it will be seen that the fineness of lines does not depend on the drawing, all that is required is a correct drawing, but the lines may be quite coarse; the shading should also be correctly indicated, but for this any convenient means may be used, the drawing may be shaded by pencil, crayon, or such like. The drawing can be made of any size, as it is photographed on the wax and increased or decreased in size as may be desired.

(586) S. D. H., Detroit, Mich., writes: We are in search of the best fire-proof covering for our veneer elevator floors. Are there any chemicals that wood can be soaked in so as to make it fire-proof, and head off any fire going up the elevator shaft? Can you give me any information on the matter? I have inquired as to what asbestos will do. *A.*—A covering of asbestos, we believe, will make the floor practically fire-proof. Several coatings of common whitewash are also recommended. Before the whitewash is put on, the wood should be thoroughly dried, otherwise the whitewash is liable to shell off. As to chemicals, we take the following from the *Scientific American Cyclopedia*, 1. By Payne's process, patenced in 1841 the timber is inclosed in a close iron vessel in which a vacuum is formed. A solution of sulphate of iron is then admitted into the vessel, which instantly insinuates itself into all the pores of the wood, previously freed from air by the vacuum, and after about a minute's exposure, impregnates its entire substance. The sulphate of iron is then withdrawn, and another solution, of muriate of lime, thrown in. The two salts then re-act upon each other, and form two new combinations within the substance of the wood—muriate of iron and sulphate of lime. Timber thus treated is preserved both from rot and from the attack of worms, and is perfectly incombustible. 2. Dr Burnett's process consists in treating the timber to a solution of chloride of zinc. 1 pound of chloride of zinc to 4 gallons of water. It requires to be immersed for about two days for each inch in thickness, and afterward left to dry for a period of 14 to 90 days. This renders the wood incombustible, but not so thoroughly as the former process It is likewise a preservative.

(587) T. E. G., Columbus, Ga., writes: Please inform me what size of steam pipe will be required for a compound condensing engine, high pressure cylinder 14×42 inches, low pressure cylinder 26×42 inches, boiler pressure 100 pounds, speed 85 revolutions per minute. The boiler is located 50 feet from the engine. Please give rule for computing the size of steam pipe. *A.*—The area of the steam pipe is found by the following formula:

$$\frac{D^2 \times S}{9,550} = A,$$

in which D denotes the diameter in inches of the high pressure cylinder; S the piston speed in feet per minute; and A the area of the steam pipe in square inches The piston speed per minute is $85 \times 2 \times 3.5 = 595$ feet. Substituting for the symbols their values, we have,

$$\frac{14^2 \times 595}{9,550} = 12.2 \text{ square inches}$$

for the area of the steam pipe, the corresponding diameter is nearly 4 inches. No increase need to be made for the given length of steam pipe. 2. What is the horse-power of this engine and how do you compute it? *A.*—We estimate the indicated horse power to be 325. To compute the horse power find the mean effective pressure as explained in answer to Question 564 in our issue of November 16th, current volume. Then apply the well-known formula:

$$\frac{P\,L\,A\,N}{33,000} = H,$$

in which P denotes the mean effective pressure; L length of stroke in feet; A the area in square inches of the low-pressure piston; N the number of strokes per minute; and H the indicated horse-power. Of course this result is only an approximate one, as the clearance, drop of pressure in the receiver, etc., have been neglected.

(588) J. S., Indianapolis, Ind., writes: Please give me a formula for computing the thickness of semi spherical boiler heads and also for spherical forms of different rise I have to calculate the thickness of head for a boiler 36 inches diameter subjected to a pressure of 300 pounds per square inch. I computed the thickness to be 1 inch, and got the same results by using the formula on page 9 in your issue of November 2d current volume. As this looked very weak I made the cover $1\frac{3}{4}$ inches thick, and the flange $2\frac{1}{4}$ inches thick. The cover could undoubtedly be thinner because its form is semi spherical. *A.*—For computing the thickness of semi spherical head we have the following formula:

$$\frac{p \times d}{4 \times S} = t,$$

in which t is the thickness in inches, p the internal pressure per square inch; d the diameter of the sphere in inches; and S the safe working stress of cast iron which may be taken at 6,000 pounds per square inch. Substituting for the symbols their values, we have

$$\frac{300 \times 36}{4 \times 6,000} = 0.45 \text{ of an inch for the}$$

thickness of the head. But since cast-iron is a very treacherous material for boilers, we should at least double this thickness, and make it, say, 1 inch; or we should put some good ribs in the head. The thickness of the flange should be equal to 1.8 times the thickness of the head $+ \frac{3}{8}$ inch. It is difficult to give a formula for computing the thickness of heads whose form is less than a semi-sphere. But for guidance we may take the other extreme and compute the thickness of a flat head. For this we have the following formula:

$$\sqrt{\frac{5 \times r^2 \times p}{6 \times S}} = t,$$

in which r denotes the radius of the head, the other symbols denote the same quantities as before Substituting for symbols their values, we have

$$\sqrt{\frac{5 \times 18^2 \times 300}{6 \times 6,000}} = 3.6 \text{ inches for}$$

the thickness. Hence the thickness of spherical heads of different rise and the given diameter should not be less than 1 inch, and need not be more than 3.6 inches. The thickness of flange, in all these particular cases, should remain the same as found for the semi spherical head.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Pattern and Brand Letters A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N. J.

Packing rings 5 cents per diam. inch. Discount on large orders. J. H. Dunbar, Youngstown, O.

Upright Drills, stationary head, W. & L. with or without B. G. J. E. Snyder, Worcester, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions R. M. Clough, Tolland, Conn.

"Pumping Machinery" New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers while the latter has flexible covers with full page opening flat Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO. 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Commodore Vanderbilt's Bookkeeping.

When Samuel Barton, the well-known Wall street broker, and now of the firm of J. W. Davis & Co., was a poor boy, he studied law in S. L. M Barlow's office. One day he received a curt summons from his uncle, Commodore Vanderbilt, and, dutiful nephew that he was, he hastened to find out what that brusque but potential old gentleman wanted of him. He found the Commodore in a high state of indignation over the faithlessness of a trusted cashier.

"Sam, I've sent for you because I want you to be my cashier," exclaimed the founder of the Vanderbilt riches, vehemently.

"But, uncle, I don't know anything about bookkeeping," protested young Barton.

"Bookkeeping be blowed!" shouted the old Commodore. "You know enough to be honest, don't you?"

"Yes, sir," promptly responded the nephew.

"Well, you know how to take money when it is paid in to you, don't you?"

"Yes, sir."

"And you know how to pay bills when I tell you to pay 'em, don't you?"

"Certainly."

"Then you would know enough to give me the balance of the money, wouldn't you?"

"Why, of course," said Barton.

"Well, that's bookkeeping."

And Sam Barton filled the bill to his uncle's satisfaction for several years.—*N. Y. Times.*

Pasteur says: "There is no applied science; there are sciences and the application of the sciences."

Fall Meeting of the A. S. M. E.

The programme of regular autumn meeting of the American Society of Mechanical Engineers has been made public, and conforms closely in arrangement to preceding meetings held in this city. The first session will be Monday evening, December 4th, at which President Eckley B. Coxe will welcome the Society, and deliver his Presidential address. The following papers will be presented during the sessions:

"The Buckeye Engine Valve Gear," by A. K. Mansfield.

"The Maximum Contemporary Economy of the High-pressure Triple-expansion Engine," by Prof. R. H. Thurston.

"Expansion Bearings for Bridge Superstructures," by Geo. A. Morison.

"A Device for Drill-jigs," by Barton Cruikshank.

"A Curve Delineator," by Frederick A. Scheffler.

"Notes on Belting," by Fred. W. Taylor.

"Some Experiments on the Effects of Water Hammer," by R. C. Carpenter.

"Constants for Correcting Indicator Springs Which Have Been Calibrated Cold," by R. C. Carpenter.

"The Use of the Indicator in Dynamometric Testing," by W. S. Aldrich.

"A New Form of Prony Brake," by R. C. Carpenter.

"A Comparison of Mean Effective Pressures of Simultaneous Cards Taken by Different Indicators," by D. S. Jacobus.

"Recent Progress in the Manufacture of Steel Castings," by H. L. Gantt.

"Steam Piping and the Efficiency of Steam Plants," by Wm. A. Pike.

"A Method of Manufacture of Large Steam Pipes," by Chas. H. Manning.

"Strength of Rim-joints in Fly-band Wheels," by Jas. B. Stanwood.

"Experimental Determination of the Effect of Water in Steam on the Economy of the Steam Engine," by R. C. Carpenter.

"Test of a Boiler Using Grates with a Small Percentage of Openings," by F. A. Scheffler.

"The Cumulative Errors of a Graduated Scale," by Wm. A. Rogers.

"A Modern Disinfecting Plant," by Wm. H. Francis.

"Crucible Furnace Using Petroleum," by W. S. Crane.

"Theory of Direct-acting Steam Pumps," by David Guelbaum.

There is a very general belief among mechanics that steel of fine quality is necessarily harder, or has a higher percentage of carbon, than steel of commoner quality. This is not the case. Steel of the finest quality is made of all degrees of softness or hardness according to the purpose for which it is to be used. There are purposes requiring steel that is made of the finest iron the world produces, and yet of a temper so mild that when heated to a bright red and cooled in water, it can be readily filed.

J. P. L., Waterbury, Conn., asks why steel has soft streaks in it when evenly heated and hardened, these sometimes appearing on the cutting edges of a die. It may be due to improper annealing or to taking off too little of the surface. The surface of a hot-finished steel bar is oxide of iron, not steel, and will not harden. This surface is a skin varying in thickness in the same bar. To insure even hardening the tool maker should get well below it. Uneven hardening is also frequently due to the use of too small a bath. For large pieces a running stream is best or a strong column of water flowing up from the bottom of a tank.—*Sparks from the Crescent Anvil.*

The material in the Fair buildings will scarcely pay for removing them.

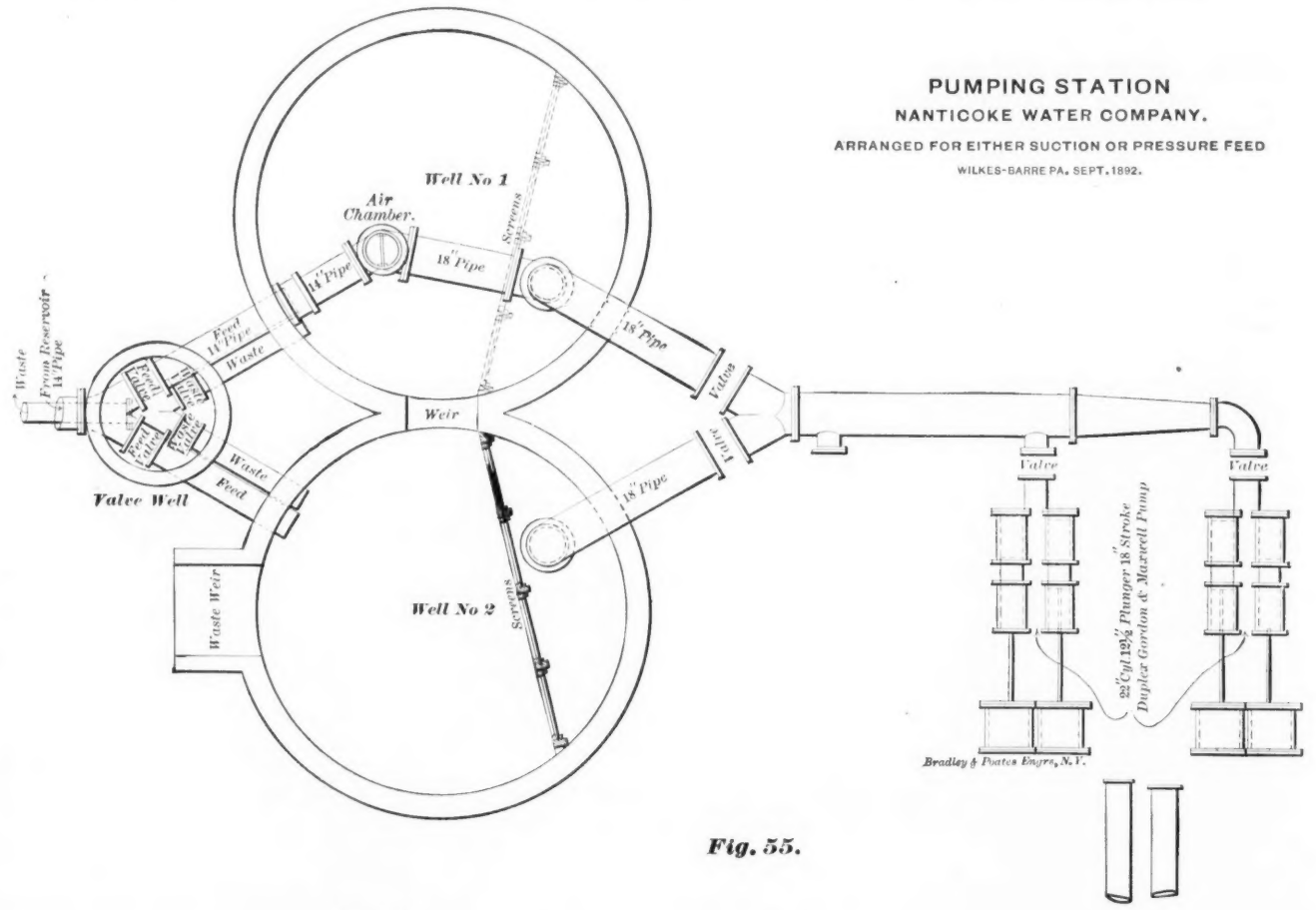


Fig. 55.

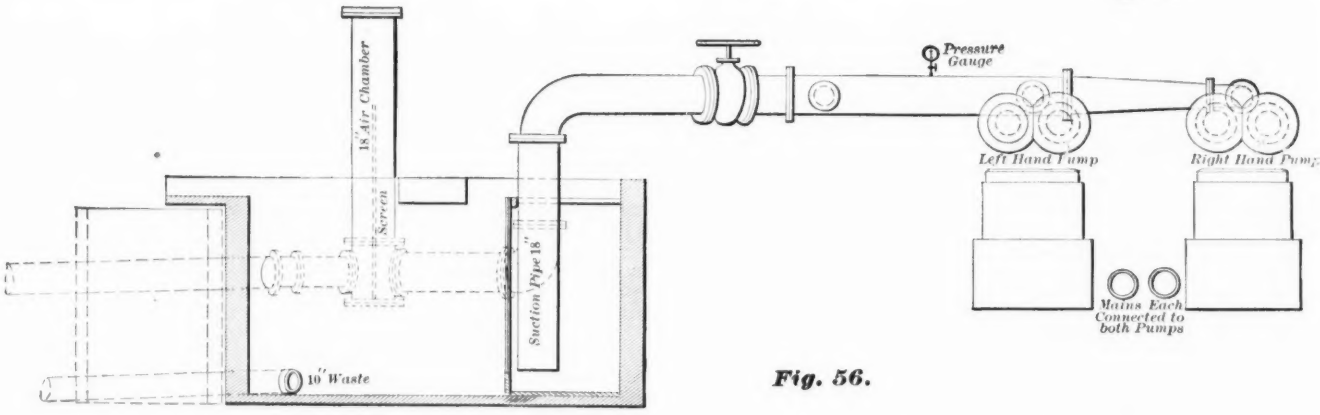


Fig. 56.

Nanticoke Water Co's Pumps. Suction and Pressure Feed.

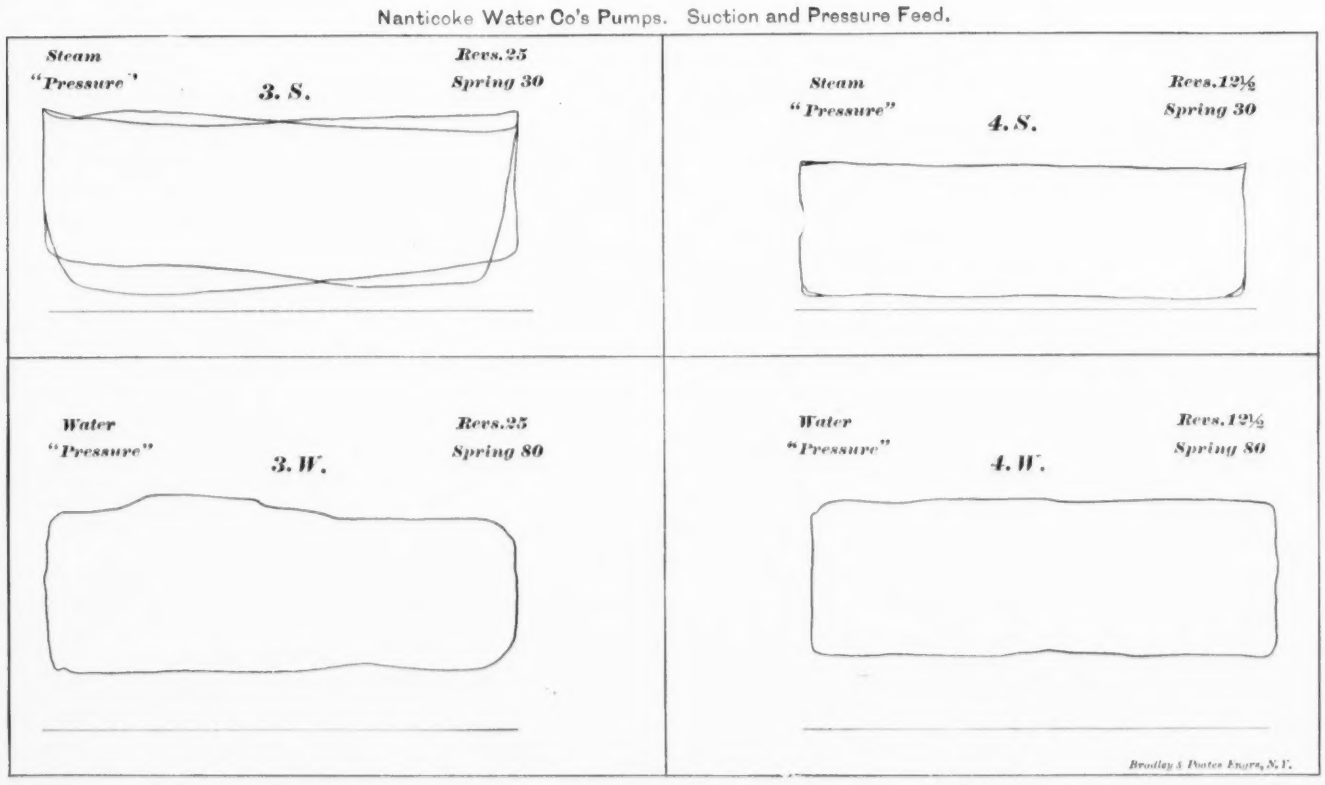


Fig. 59. TESTS OF PUMPS. *Fig. 60.*

Tests of a Pump Receiving Suction Water Under Pressure.*

BY R. VAN A. NORRIS, WILKES-BARRE, PA.

The following experiments were made in April, 1892, with the view of determining the advantages of the plan of feeding water under pressure to a direct acting pump over that of drawing the water from a receiving well. The circumstances were as follows:

The borough of Nanticoke, Pa., is supplied with water from Harvey's Creek, a small stream tributary to the Susquehanna, the water being conducted through mains from a dam some two miles up the creek, and reaching the Nanticoke Water Co.'s pumping station with a piezometric head of about 60 feet when the pipe is flowing about 1,000,000 gallons per day. Up to the above date the water had been discharged at the pumping station into two receiving wells (Fig. 55), and thence pumped into the town mains by two duplex Gordon and Maxwell pumps, 22-inch steam cylinders, 12½-inch plungers, 16½ inches actual stroke. It was suggested by Mr. J. H. Bowden, the chief engineer of the company, that the pressure of water in the mains could advantageously be used in feeding the pumps. Accordingly one well was thrown out of use, and the connection shown in Fig. 55 put in, consisting merely of an 18 inch pipe connecting the suction of the pumps to the inlet from the main, and extending across the No. 1 well, with a 10-foot length of 18-

*A paper read before the American Society of Mechanical Engineers.

The last session will be held Friday 8th at 10 A. M., and the afternoon of each day is, as usual, left without special assignment. A reception will be held at Sherry's, Wednesday evening, at 8.30.

inch pipe standing vertically as an air chamber, to obviate any danger to the pumps from water ram. In this air chamber, and extending to the bottom of the tee to which it was connected, was a movable screen for removing any floating material from the water. This screen is readily removed from the bottom for cleaning.

Both pumps, it will be seen, were arranged to draw from either well, so that no stoppage was necessary in making the change; and when it was desired to change from suction to pressure, or *vice versa*, all that was required was the opening of one valve, and the closing of another.

The pumps are supplied with steam from the Susquehanna Coal Co.'s boilers at their No. 2 shaft, distant about 150 feet, through a 6-inch wrought pipe, and just before the pressure was turned on they were both making 25 single strokes of each plunger per minute, sucking their water from No. 2 well. As soon as the valves were changed their speed increased to 33 strokes, without change of steam valves, and they appeared to run much more smoothly.

The accompanying indicator cards were taken on April 9th by Mr. Bowden and the writer, and the results in following table not altered by the change in method of feed.

These experiments were made simply for our own satisfaction, and while not carried far enough to be of exact quantitative value, it is hoped that they will be of some interest sufficient to elicit discussion.

TESTS OF NANTICOKE WATER COMPANY'S PUMPS, APRIL 9, 1892.

PUMPING FROM WELLS AND DIRECT FROM SUPPLY MAIN. TESTED BY J. H. BOWDEN AND R. VAN A. NORRIS.

Gordon and Maxwell Duplex Plunger Pumps. 22 inch steam. 13½-inch plungers. 16⅝ inches stroke.	Condition of working.	Single strokes each plunger per min.	Average mean effec. pressure, steam.	Average steam consumed per hour.	Average pumping pressure above atmos., lbs.	Average pressure in tail pipe, lbs.	Average back pressure on plunger, lbs.	Per cent. pressure in tail pipe utilized.
Right-hand pump.. ..	Suction ...	50	36.1 lbs.	3,156 lbs.	93.5	$-3\frac{1}{10}$		
	Pressure ..	50	24.75 lbs.	2,420 lbs.	99 6	$+30$	$25\frac{3}{10}$	$85\frac{1}{10}\%$
	Difference	.....	11 35 lbs. $31\frac{5}{10}\%$	736 lbs. $23\frac{3}{10}\%$				
	Suction	25	33 4 lbs.	1 358 lbs.	91 9	$-3\frac{7}{10}$		
	Pressure...	25	23.1 lbs.	1,060 lbs.	97.3	$+32$	$29\frac{4}{10}$	91%
	Difference.	.....	10.3 lbs. $30\frac{8}{10}\%$	298 lbs $21\frac{9}{10}\%$				
Left-hand pump	Suction ...	50	33.9 lbs	2,912 lbs				
	Pressure...	50	25.25 lbs	2,369 lbs				
	Difference.	.....	8.65 lbs. $25\frac{5}{10}\%$	543 lbs. $18\frac{6}{10}\%$				
	Suction	25	32.4 lbs.	1,314 lbs.				
	Pressure...	25	23.3 lbs.	1.060 lbs				
	Difference.	.....	9.1 lbs. $28\frac{1}{10}\%$	254 lbs. $19\frac{3}{10}\%$				

Indicator Cards from Steam and Water Cylinders.

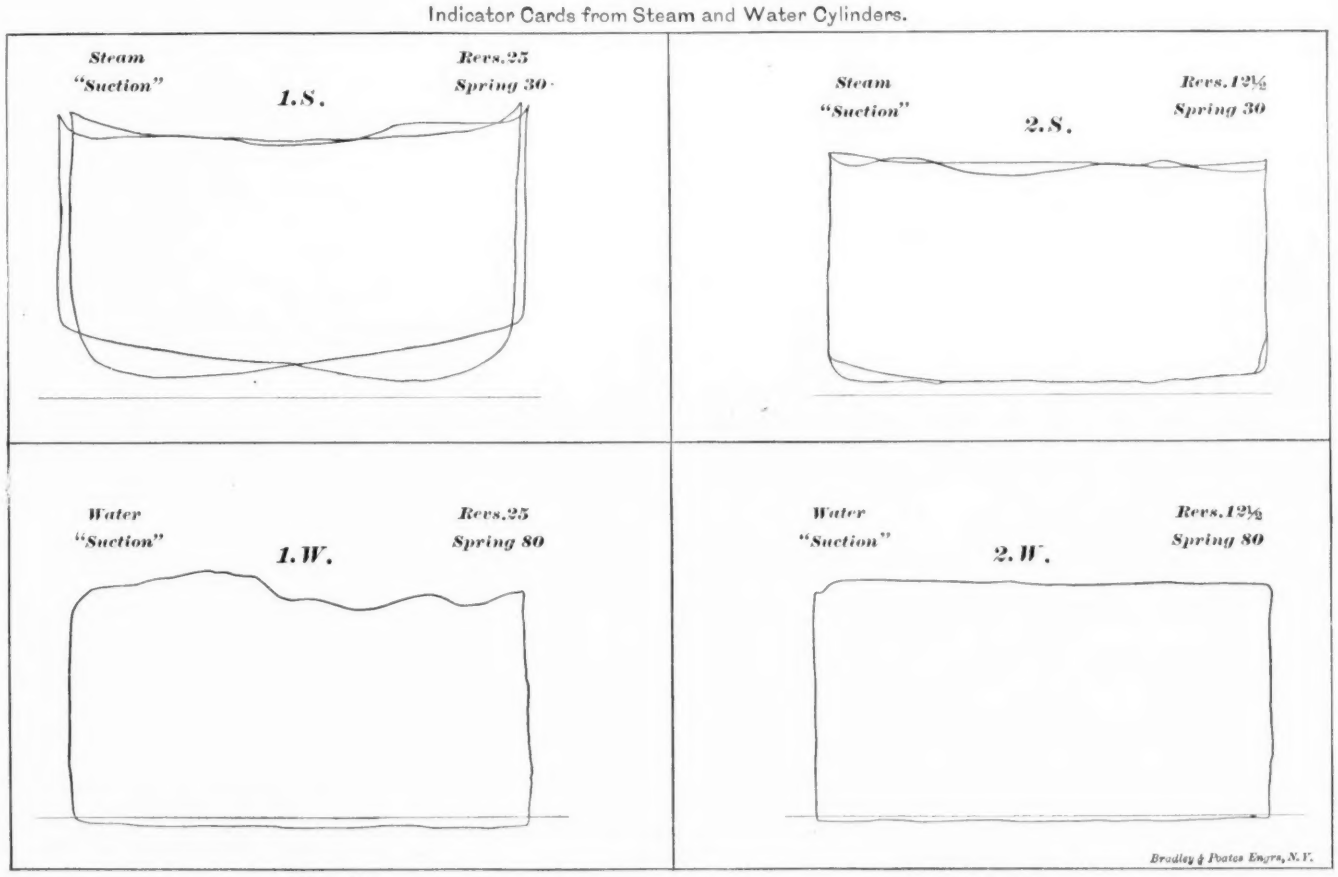


Fig. 57. *Fig. 58.*

calculated from them. Four cards were taken from each end of each cylinder under each condition, and the results in the table are averages from them. The pressure in the "suction" pipe was determined by a pressure gauge in the position shown, read at time of taking each card. Cards were taken under the following conditions:

Suction from well, 50 strokes of each plunger, cards 1 *S.* and 1 *W.*

Suction from well, 25 strokes of each plunger, cards 2 *S.* and 2 *W.*

Pressure from main, 50 strokes of each plunger, cards 3 *S.* and 3 *W.*

Pressure from main, 25 strokes of each plunger, cards 4 *S.* and 4 *W.*

They seem to show that about 90 per cent. of the gauge pressure in the main was utilized, and that the resulting saving in steam calculated from the cards was about 20 per cent.

No measurement of the water pumped under the two conditions was attempted, as it went directly into the supply pipes; but the pumps appeared to work more smoothly and to keep the stand-pipe level more constant under pressure than when sucking.

The suction valves of the pumps were provided some years ago with springs to make them seat promptly, and these were

Center Blast Cupola.

Thomas D. West writes:

T. Beverly Keim, in your issue of November 16th, asks what foundries have the center blast cupola in use, and where they can be bought; also can the center tuyere be applied to a ten ton cupola. To the first question I can only answer, that so far I only know of Mr. Widdowson and myself as having the device in use, and not until the appearance of the appended article, "Remarkable Coincidence," which appeared in *The Foundry*, November 10, 1893, had I any knowledge of any one having used such. The article will no doubt express all that is necessary to say upon the past use of the device.

As to the second question, the article referred to seems to show that it is nowhere manufactured, and any one desiring to give such a trial cannot go very wrong if he will but closely follow the details of construction as outlined in the article so well presented in the AMERICAN MACHINIST November 2, 1893, in which I endeavored to state all the ills as well as successes I met with in my experimenting with the device, so that any one trying or using same would have every chance of making a success of the scheme.

You will notice that Mr. Hibler in his claims on the device, says it will save one-third of the fuel. There is no question about its economy, and any one trying it would soon find such to be demonstrated.

In regard to the device being applicable to a ten-ton cupola, I would say yes, and down to as small as a five-ton. For his ten-ton cupola, I would advise him to use the center tuyere two inches smaller in diameter than that shown in the illustration, and if he will "slag out" his cupola well, he will find no trouble in his "bottom dropping" with any ordinary heat, if the instructions given in the article of November 2d are only followed. Of course, if it is an exceptionally large heat, he would—in a cupola as small as ten ton—be liable to have trouble in any cupola if it was not handled properly, and it would be the same in the case of using this device.

With reference to the No. 8 fan, it is a good thing to have a fan on the large side, and about all I can say with statistics before me as regarding size of tuyere, blast pipes, etc., is, he could best decide the quantity of blast necessary by trial when he had this device in use.

Any one desirous of trying the device should have no trouble in getting almost any boilermaker to construct the main part of it from the ideas illustrated in the article in the AMERICAN MACHINIST, and the foundryman should be able to construct the rest. The device is simple, and any one having a little confidence in his own ability will have no difficulty in constructing and using it.

[The article from *The Foundry* to which Mr. West calls attention is as below.—ED.]

REMARKABLE COINCIDENCE.

Elsewhere appears an article read by Mr. Thomas D. West, at the Western Foundrymen's Association, October 18th last, in which he gives a detailed account of some experiments made by him with a view of introducing the blast to a cupola through the bottom, and by a tuyere that permitted the passage of the blast into the cupola in the center of the "bed," or first charge of fuel. Mr. West worked for a year or two at the idea and its developments, and early this year thought of patenting it, even going so far as to write to a prominent and well-known patent solicitor in Sharon, Pa., for his opinion as to whether the idea was a patentable one or not, and he replied in a letter which we have seen, giving his opinion that it was, after having a careful examination made by the Hon. Ellis Spear, at Washington, D. C. Some time after this Mr. West received a letter from a well-known foundryman, Mr. Thomas H. Widdowson, of Mankato, Minn., informing him (Mr. West) that Mr. Widdowson had also been for many months at work on exactly the same thing, and giving the results of his experiments. Mr. West makes appropriate notice of this in his paper read in Chicago. Now, this was a coincidence pure and simple, and an extraordinary one at that, but the remarkable part of it all is that this same center blast cupola had been patented August 13, 1867, No. 67,651, by B. H. Hibler and the Pittsburgh & McKeesport Car Co., at which time it was thoroughly tried with a saving of one-third in the fuel used, it being afterward introduced and successfully tried by Mr. Hibler, who was a practical foundryman, in the Excelsior Stove Works, Quincy, Ill. *The Foundry* heard a rumor of these facts, and wrote Mr. West on the subject with the result that we have received from him a mass of evidence proving conclusively that he could not possibly have heard of Mr. Hibler's patent, including the original correspondence with the patent attorneys, etc.

The reason Mr. West did not further attempt to patent the idea was because he had something else in view that, it appeared to him, would be still better, and while the records show that Mr. Hibler was evidently first with his idea, yet it is also clear that both Mr. Widdowson and Mr. West were of the opinion that they were first with it.

That it has not come into more general use is owing probably to the awkwardness and disadvantage of the plan proposed of getting the blast to the place through the bottom, but we will have more to say on this subject in our next issue.—*The Foundry.*

"The Amster-dam Rascals."

Our readers continue to show interest in the doings of what Bement, Miles & Co. call the "Amster-dam rascals;" among the letters recently received being the following:

BALTIMORE, MD., Nov. 18, 1893.

Editor American Machinist:

SIR:—We read with interest the letters and information given in your last issue on "The Amsterdam Rascals."

We, too, were "favored" with an order, from Du Chatinier & Co., but requested payment before shipment. They replied that it "was the mode of their house to send draft after arrival of goods," and referred to any banker in Amsterdam as to their standing.

A bank in Amsterdam furnished us the inclosed list of some one hundred parties from whom "*il est tres difficile d'obtenir paiment.*" The machine was not shipped. You are free to use the list and to publish this letter.

DETRICK & HARVEY MACHINE CO.

The list mentioned contains many names not found in the official list already published. We shall have to again give up the idea of publishing the names of all in Amsterdam who are dishonest, and in any event the proper course to pursue in such matters is indicated in the letters we have published.

Electric Canal Boats.

On November 18th, there was an official trial of electricity as a motive power for canal boats on the Erie Canal. The test was made not far from Rochester, and is declared to have been entirely successful. A trolley line is used, the wire being stretched over the canal in much the same manner as it is stretched over the streets of cities, except that two wires and two trolleys were used, one wire and trolley being for the return current The motors were of the Westinghouse type about as are employed for street cars, but in this case used to turn propellors. It is the intention to build electric tug boats to draw other boats, and electricity is expected to be taken from the Niagara Falls plant.

A large profit sharing concern is that of the N. O. Nelson Manufacturing Company, St. Louis. At its works in Leclaire and Mound City, Ill., and St. Louis it employs about 500 hands. During the seven years ending with 1892 it paid to wages a total dividend of 54 per cent. In 1889 the day's work was fixed at nine hours without reduction of wages. Early in July last, owing to depression in its trade—plumbing ware—it was mutually agreed that three-fourths of the wages should be paid in cash, the other fourth to be paid whenever the net profits should exceed interest on capital at 6 per cent. during the months of full pay, and at 4½ per cent. during the term of three quarters pay. On October 1st the company's business had improved to a point warranting return to the full cash payment of wages.

The Marine Engineers' Beneficial Association No. 35, San Francisco, Cal , has established a Mid winter Entertainment Bureau at No. 9 Mission street, for the purpose of maintaining headquarters for visiting engineers during the continuance of the mid winter fair. Engineers can have their mail addressed there, meet one another socially and obtain information as to rooms, hotels, routes, etc. All are cordially invited.

The Engineering Record, of this city, announces the early publication of a series of papers on "The Engineering of Architectural and Building Construction." The papers will be written by Mr. Wm. H. Burr, Member American Society Civil Engineers, who is thoroughly competent to deal with the subject, and the papers ought to prove of very great value.

The fifth of the large guns for the navy has been completed. The guns are 13 inch caliber. A gun with its carriage costs half a million dollars. The projectile used weighs 1,150 pounds and the powder charge is 550 pounds. It costs $675 to fire the gun, and it is calculated to be good for not more than 500 rounds.

A plot of ground at the corner of Broadway and Pine street, this city, recently sold at next to the highest price ever paid in this city. The price was nearly $286 per square foot, which is equivalent to about $12,458,160 per acre.

It is reported that the Westinghouse Company, of Pittsburgh, will make and install at Niagara three dynamos of 5,000 horse power each, which are said to be the most powerful dynamos ever constructed.

MANUFACTURES.

The Knoxville (Tenn.) Engine and Pump Works will erect a foundry.

A. F. Merrill & Co.'s spool factory, East Eddington, Me., has started.

The Stil l River Stool Co., of New Milford, Conn., has doubled capacity.

The Mims Iron Works Co , New Orleans, La , will rebuild its pattern shop.

Kerr & Morgan, machinists, Montreal, Can., are enlarging their business.

The new works of the Gould Car Co., at Depew, Pa., have been completed.

A combine of all the natural gas companies in Lima, O., has been formed.

J. M. Merrifield & Son have started up their bobbin-mill at Kezar Falls, Me.

The Cleveland Rolling-mill Company's rail-mill at Cleveland, O., has been started.

A fire in Allentown, Pa., destroyed the large planing mill of James M. Ritter.

The Illinois Steel Company's Bay View plant has started up in all its departments.

The Joliet Rolling mill at Joliet, Ill., has resumed work after eleven months' idleness.

The Woodville (N. H.) Manufacturing Co. has been organized, with capital of $150,000.

The mill of the Front Rank Steel Furnace Co. St. Louis, Mo., is being run double time.

H. Tadaferro and William Collier have started the manufacture of barrels at Gloucester, Va.

The prospects for resuming full time at J. B. Sargent & Co.'s, New Haven, Conn., are good.

J. W. D. Hall and L. M. Roscoe have organized the J. W. D. Hall Cornice & Mfg. Co , St. Joseph, Mo.

The Valley Foundry and Machine Co. is about to start a foundry and machine works at Johnson City, Tenn.

The old Panhandle Glass Works, at Wellsboro, Pa , after being idle for nine years, has been started up again.

Stirling Co., New York, report recent sale of 975 horse power Stirling boilers to the American Straw Board Co.

Fire destroyed the Chicago & Grand Trunk repair, oil and blacksmith shops at Chicago on November 20th.

Work will be resumed at the Joliet mills of the Illinois Steel Co on November 27th, giving employment to 1,800 men.

The factory of the Utica Fire Brick Co., Utica, Ill., was burned to the ground November 12th. The loss is $200,000.

The rolling-mill of the Keystone Machine Works, at Goshen Bridge, Va , has been sold to the Virginia Iron Company.

The foundry and machine shops of E. C. Wehrfritz, Little Rock, Ark , were destroyed by an incendiary fire; loss $40,000.

The Pittsburgh Reduction Co., manufacturers of aluminum, has let the contracts for building its new shops at Niagara Falls.

The Rosera furnace at New Castle, Pa., has started up. The Etna furnace will blow in just as soon as it can be put in shape.

The Sutton Manufacturing Company's mills at Wilkinsonville, Mass., which have been closed all summer, will start up Monday.

The Buffalo (N. Y.) Paragon Wall Plaster Co. has been incorporated. Capital, $30,000, and directors, H. C. Harrower and others.

Burrill & Bradbury, the purchasers of the Donnell lumber lot at Cooper's mills, Whitefield, Me , are erecting a steam-mill for manufacturing long and short lumber.

The Wheeler Condenser and Engineering Co , 41 Cortlandt street, New York, supplied the cruiser "Columbia" with surface condensers for the auxiliary power.

The Caldwell water tube boiler is now being manufactured for the West by the Link Belt Machinery Co., of Chicago, with sales agencies in the principal cities.

At Laconia, N. H., the freight department of the car works is now being run to its full capacity, there being orders enough ahead to keep 350 men at work for at least four months.

Blast furnace No. 6 of the Cambria Iron Works, Johnstown, Pa., after a shutting-down of nine months started up November 20th. This will give employment to probably 300 men.

The Addyston Pipe and Steel Co., Cincinnati, Ohio, special machinery of all descriptions, and heavy castings, has issued a new catalogue giving an idea of its general and special work.

New London (Conn.) business men are discussing the enterprise of erecting an industrial building for small manufacturers on the plan of the one erected in Hartford about two years ago.

The Crucible Company, of Bridgeport, whose works were destroyed by fire a few days ago, will make arrangements to continue their work in another factory in a few days, and will rebuild.

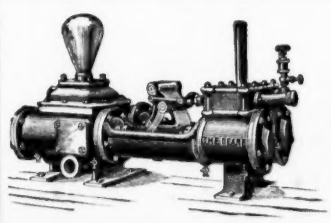
An organization has been effected of the New East Hartford (Conn.) Electric Light and Power Co., P. S. Bryant being elected president, A. C. Liebert, secretary, and L. S. Forbes, treasurer.

The Youngstown (O.) Bridge Company, which has been working nearly to its full capacity, is compelled to shut down by reason of being unable to secure certain kinds of iron to complete contracts it is working on.

At Harrisburg, Pa., the Emporium Steel Co. has been formed. The officers are: President, J. Pitt Felt; vice-president Hon S S. Smith; treasurer, J hn D. Logan; secretary, L. K. Huntington; superintendent, R. L. Watters.

The Jos. Dixon Crucible Co., Jersey City, N J , issue a very instructive pamphlet relating to the use of graphite for lubricating purposes. Every engineer and mechanic should write for one. It may help him out of trouble some time.

Several of the large iron mills at Youngstown, O , which have been shut down for twenty three weeks, started recently as a result of the settlement of the wage scale question on a basis of $4.75 for puddling, and the finishers' scale of the Finishers' Union.



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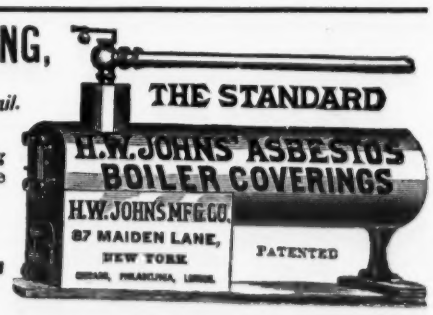

The Marlin Iron and Steel Co., of Allegheny City, Pa., has been chartered, with a capital of $40,000. The directors are Henry A. Marlin, Francis D. Marlin, John B. Chapman and Perry O. Laughner, of Pittsburgh, and Elmer E. Laughner, of Coraopolis, Pa.

The Pittsburgh *Commercial Gazette* says: Developments of the last few days confirm the report that the Standard Oil Company is preparing to engage in the manufacture of steel on a gigantic scale, and outdo the Carnegies and all other concerns of the country.

W. H. Van Houten, principal proprietor of the Novelty Iron Works, at Naples, N. Y., has purchased a water-power plant at Gorham, N. Y., consisting of saw and planing-mills, cider mill, machine and blacksmith shops, etc., and will put in some new machinery in the spring.

The State Street Horse Railway Co., at New Haven, Conn., have placed the contract for the roof on their new power house with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 84 ft. wide and 250 ft long, the roof trusses being of iron, covered with slate.

Raymond's foundry and woodworking shop in Westbrook, Me., are doing a lively business. In the former a new and a larger furnace is being put in to take the place of the old one. This change was made necessary by the increase in orders which have been pouring in of late.

The Belknap Motor Company, Portland, Me., have been awarded the contract for the light plant for the Vermont State Insane Asylum at Waterbury. Other orders have been received recently from Washington, D. C., Wilkesbarre, Pa., Cohocton, N. Y., St. Louis, Mo., Ellsworth, Me., and Greeley, Colo.

The Cincinnati Milling Machine Co., Cincinnati, Ohio, has issued a very neat catalogue of their new universal cutter and tool grinder as improved. In addition to cutters and tools, circular and surface grinding may be done with this machine. The catalogue is freely illustrated with cuts showing the manner of operating on different pieces. Sent free.

The Pearl Square-Auger Manufacturing Company, with $10,000 capital stock, has been organized at Berwick, Me., for the purpose of manufacturing and dealing in tools and machinery. The officers are: President, Azariah Y. Pearl, of Lebanon; treasurer, Allen E Oswell, of Lebanon. The company's specialty will be the manufacture of the auger for boring square holes that was lately described in these columns.

The National Pipe Bending Co., write us: The American Linen Co., Fall River, Mass., are remodeling to some extent their steam plant, having put in a 1 500 horse-power engine, and a 2 000 horse-power National feed water heater, which was manufactured by the National Pipe Bending Co., New Haven, Conn. The National feed water heater was exhibited at the World's Fair, and received the highest award, a gold medal and diploma.

The Montour Iron and Steel Co. has resumed operations in its rolling-mills at Danville, Pa., giving employment to 600 men. Nearly all the other large iron industries there are now in operation also. Four more furnaces at the Ellis & Lessig puddling mill, in Pottstown, have resumed work making 22 now in operation. At the Pottstown Iron Company's Works the Hope Mill which has been idle for several months, has been started up

Mr. O. C Crane has brought out a new portable drill which appears to be a handy little tool. Adjustable on an upright post are two clamps for fastening the tool to any convenient detail, and the height of the drill or distance from the work, as well as the distance from the post, can be very quickly adjusted. There is screw-feed and adjustable crank motion, with a ratchet attachment for use where continuous crank motion cannot be employed. Manning, Maxwell & Moore, 111 Liberty street, are selling agents.

A press dispatch from Scranton, Pa., November 21st, says: Carl McKinney, late of the Pennsylvania Steel Company, at Sparrow Point, Md., having been made General Manager of the Lackawanna Steel Works here, to-day gave notice that all the machinists, blacksmiths, carpenters, patternmakers, and foundrymen of the South Mills, 200 in number, will resume work to-morrow after an idleness of five months. The entire steel works are soon expected to begin work. The furnacemen of the company have also been ordered to duty. They number 300.

A new rubber company has been formed in Middletown, Conn., to be known as the Middlesex Rubber Company. The factory formerly occupied by the Stiles & Parker Press Company has been bought, and work will be begun as soon as the necessary machinery is set up. The capital of the company is $75,000, and the officers are: President, H. H. Francis, formerly superintendent of the Hartford Rubber Works Company; secretary and treasurer, D. M. Baldwin, of Hartford; superintendent, A. C. Squires, of Brooklyn, N. Y., formerly of the Canfield Rubber Company.

Work on the new boiler room of the Burden Iron Company is progressing quite rapidly. The building is to be one story high, and 50x114 feet. The walls have nearly been constructed. The structure will contain from 10 to 12 boilers. In this building will be placed the new ones being made by Pinkerton & Mull of Green Island. These boilers will be used only for the blast furnace. The one used at present for the furnace is constructed over it. There are at present 46 puddling furnaces at the steam mill in operation. The rivet factory and two horseshoe trains are also running. One furnace and one horseshoe train are running at the water-mill It is probable that the same departments will be running next week.—Troy (N. Y.) *Evening Standard.*

The Tradesman, Chattanooga, Tenn., in its review of the industrial situation in the South for the week ending November 20th, reports that while the week shows no increase in the organization of new plants, the average has been maintained. There is a continued demand for machinery of all kinds, and larger number than usual of manufacturing establishments are adding to their equipments Somewhat more of inquiry for iron products is reported, with no change in prices, and coal mines are increasing their output Southern textile mills are doing well. Farmers continue to believe that cotton will bring higher prices, and those who can do so are holding their crops. The large crops of rice and sugar are making money easier along the lower gulf coast, and mercantile business is prosperous for the season. *The Tradesman* reports thirty new industries as established or incorporated during the week, together with eight enlargements of manufactories, and ten important new buildings. Among noticeable new industries of the week may be mentioned the Georgetown, Tex., Electrical Company, with $100,000 capital, organized by A. S. Fisher and others; the new rolling-mill of the Whitaker Iron and Steel Company, at Wheeling, W. Va., to cost $100,000; a wagon factory to cost $60,000, at Little Rock Ark., by R. H. Rahn, of Dayton, O; the Adams Drug, Paint and Oil Company, of Savannah, Ga. capital, $50,000, by J. W. Preston and others; the Cherokee Mining and Milling Company, of Atlanta, Ga., capital, $50,000 by Frank Messer and associates, and the Bayard Lumber Company, of Bayard, W. Va., capital, $25,000, by G. W.

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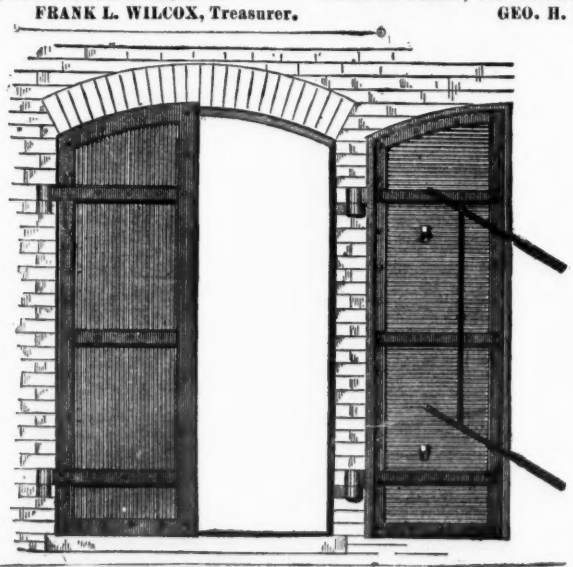
Engineers, Architects and Builders of

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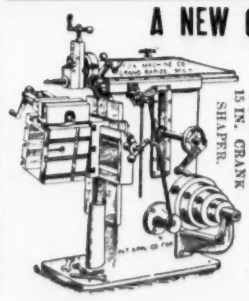

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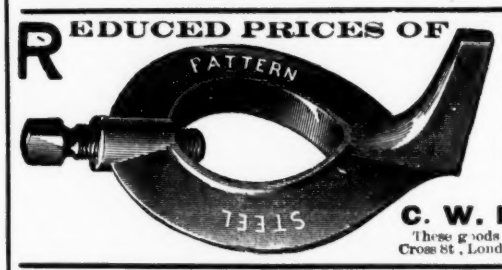

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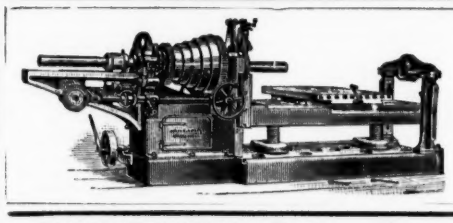
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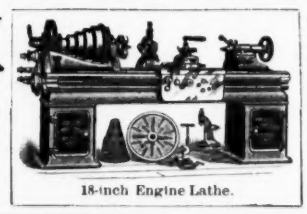
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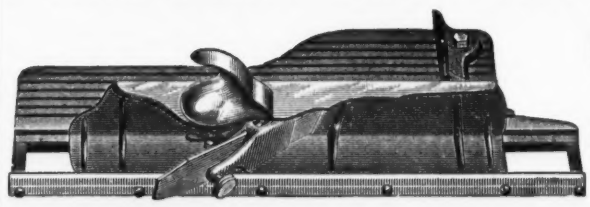
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Machinists' Supplies and Iron.

New York, November 22, 1893.

Iron—American Pig We quote Standard Northern brands No. 1 Foundry, $14.00 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $12.00 to $13.00 for No. 2, and $11.25 to $12.00 for Gray Forge.

Antimony—The market is quiet and easy. We quote L. X., 9¾c. to 9¾c.; Cookson's, 10c. to 10½c.; Hallett's, 9½c. to 9¾c., and U. S. French Star, 10c.

Lard Oil—Prime City is quoted at 75c. to 76c.

Copper—The market is quiet, but steady. For Lake Copper 10c. is asked, but probably 9¾c. would buy. Casting Copper is held at 9.40c. to 9.50c.

Lead—The market is quiet. There are buyers at 3.37½c. for spot, and 3.37½c. to 3.40c. for the balance of the year.

Spelter—The market is firmer; holders are asking 3.72½c. to 3.80c. There are inquiries for future delivery, with 3.67½c. bid.

Tin—The market is dull, without any material changes from our last report. Buyers are bidding 20.65c. for spot, and 20.70c. for the balance of the year.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

A reliable mech. draftsman (age 25) desires position A1 refs. Address Box 133, Am. Machinist.

Mechanical draftsman, Swede, wants position. Box 127, American Machinist.

Comp. draftsman, college grad., exp'd in eng. and boiler work, wants steady pos. O. K., Am. Mach.

Draftsman, exp'd in mach. tools, jigs, fixtures, and gen. mach'y, desires pos. M., Box 76, Am. Mach.

Mech. draftsman, young man, wants pos. as ass't. Salary at first not an object. J. W. F., Am. Mach.

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Wanted—Position by a first-class steam fitter. Thoroughly understands power and heating work; can draft plans for all kinds of work. Temperate & reliable. J. P. Lisk, 636 Monroe St., B'klyn, N. Y.

Wanted—Exp'd mechanic to manage growing bus. mfg small hardware specialties, contract and model work. Fine opportunity for capable man with pluck and small capital. Box 872, Hartford, Conn.

Wanted—A machine shop foreman on steam engine work. Only first-class and experienced men need apply. To such a man we offer a permanent pos. and good salary. Engine Builder, Am. Mach.

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Patternmaker, 25 years' experience, 14 years foreman, desires situation; experience, engineering, electrical and textile for green sand and loam castings; best of refs. Address Box 130, Am. Mach.

MISCELLANEOUS WANTS

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Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Monitor lathe $85; screw-cutting lathe 18" swing $85; engine and boiler 10 H.P. $110. 229, Am. Mach.

Wanted—Light machinery or specialties to build. P. G. Fleming's Machine Works, Elizabeth, N. J.

Agents—$5 Speed Gage, new, valuable, sells; shows constantly speed and slightest variations; Geo. T. McLauthlin & Co., 120 Fulton St., Boston.

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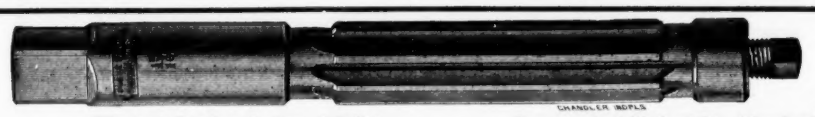

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18 " 8 "	Plain Rest—Cross-Feed.	Putnam
20 " 8 "	Compound Rest—Cross Feed.	Putnam
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21 " 4½ "	" "	Whitcomb
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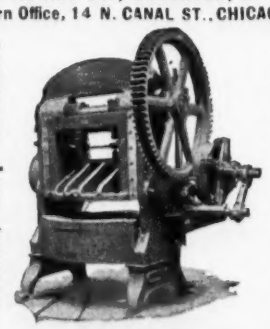

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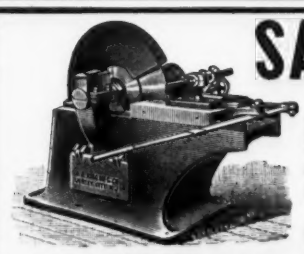

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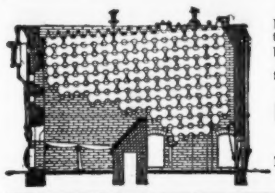

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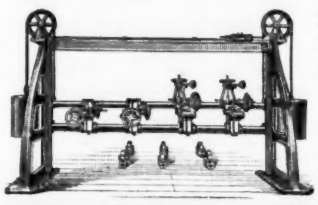

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Fitted for FOOT or STEAM POWER.
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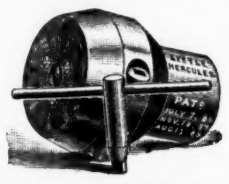

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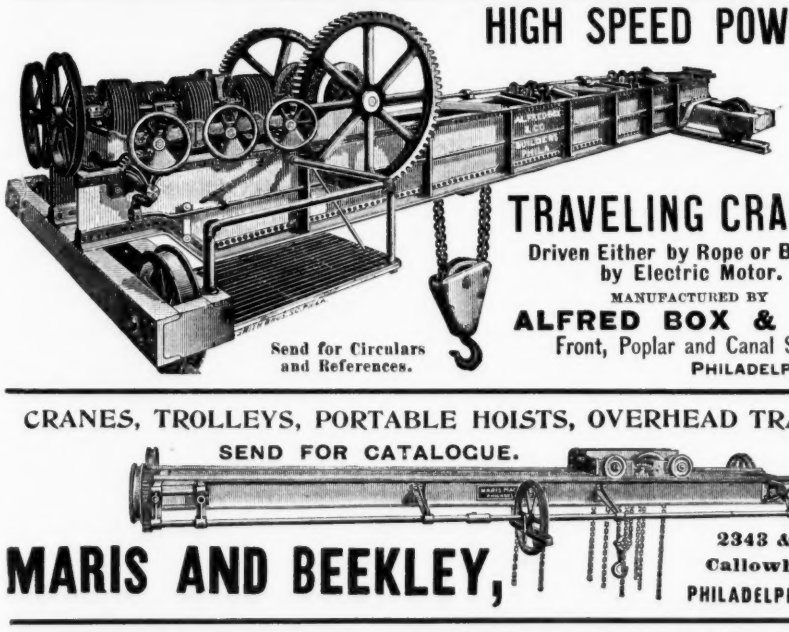

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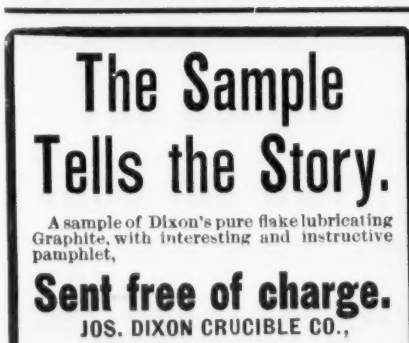

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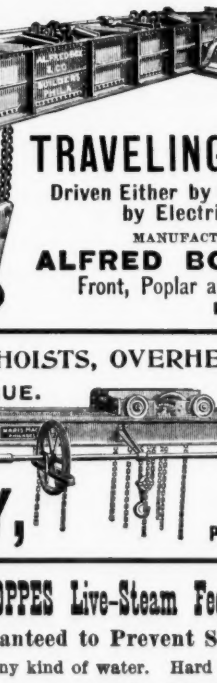

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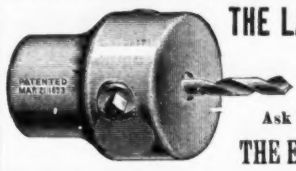

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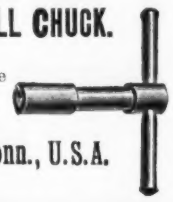

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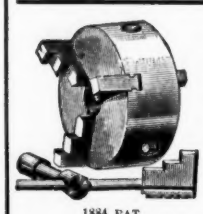

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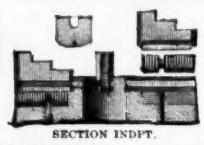

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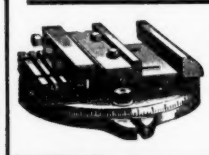

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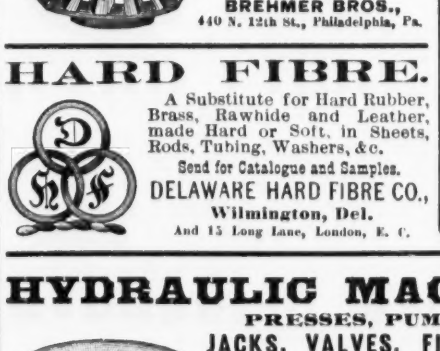
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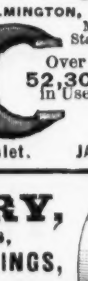

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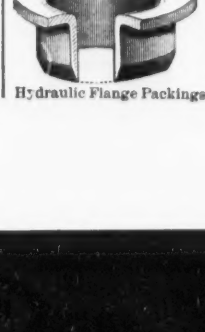

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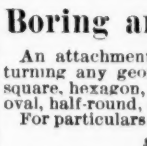

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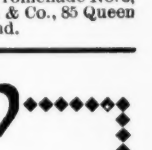

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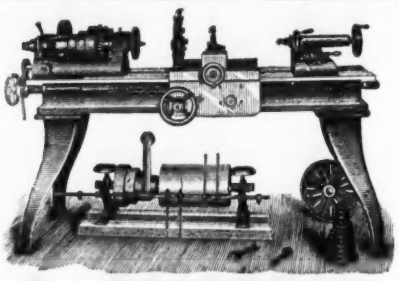

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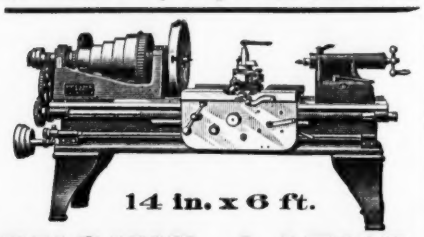

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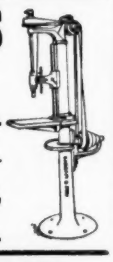

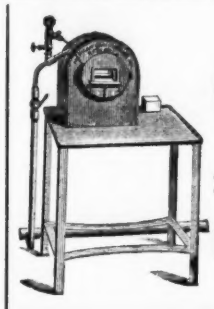

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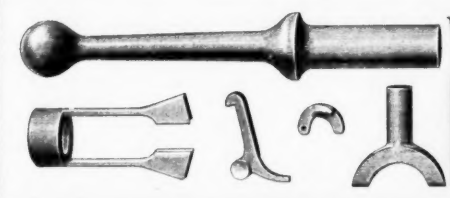

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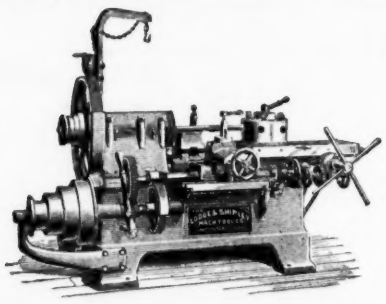

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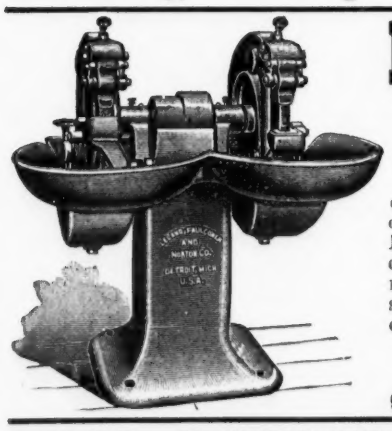

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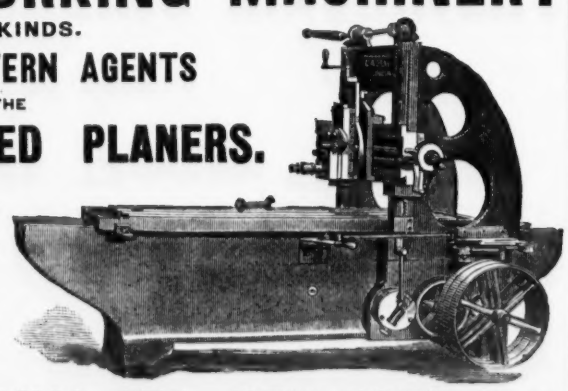

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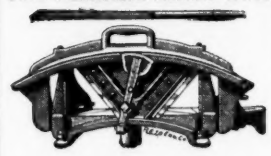

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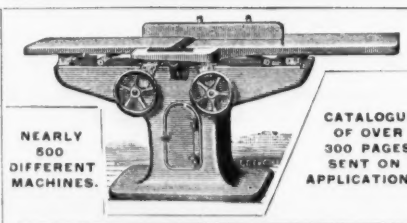

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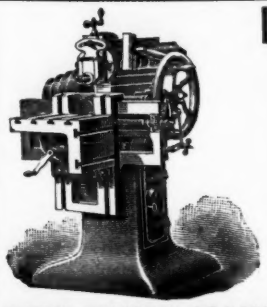

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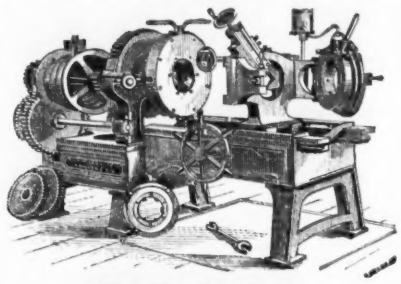

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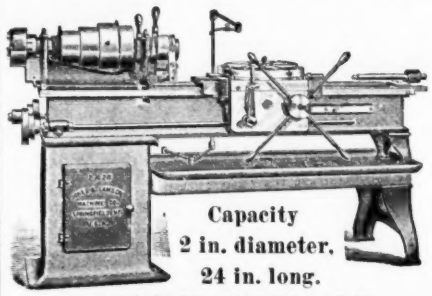

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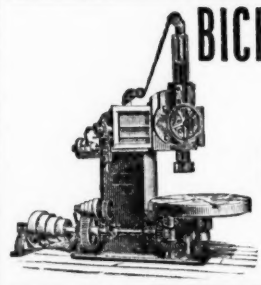

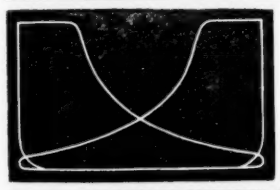

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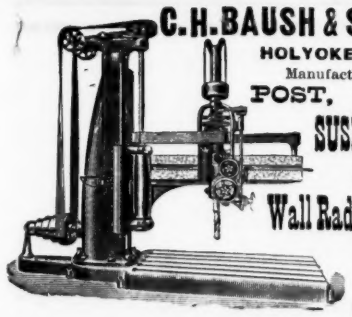

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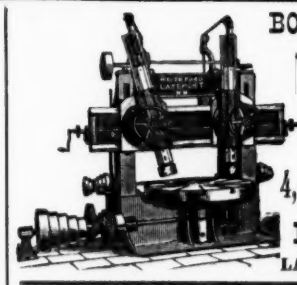

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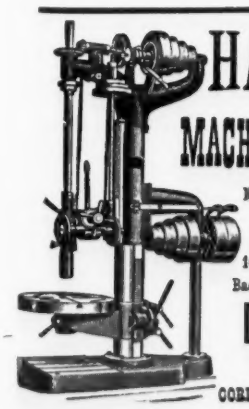

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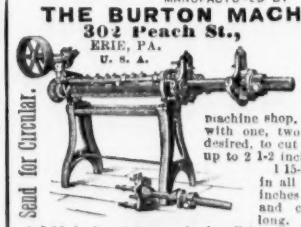

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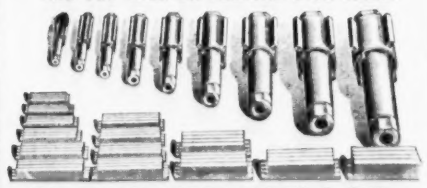

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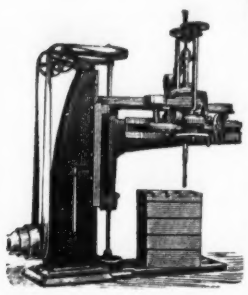

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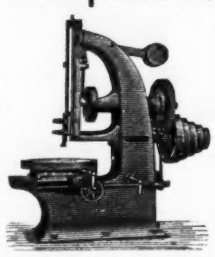

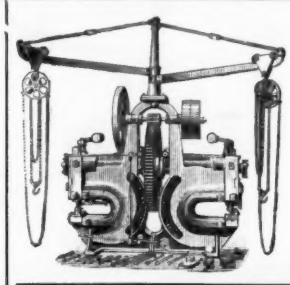

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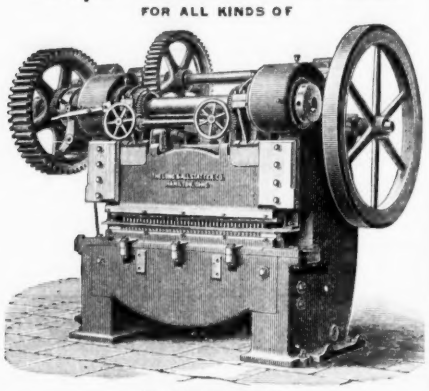

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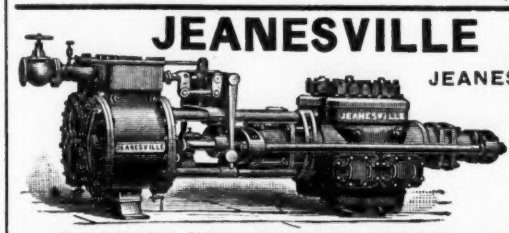

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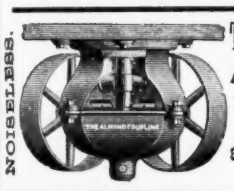

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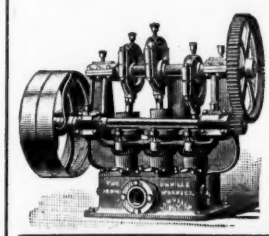

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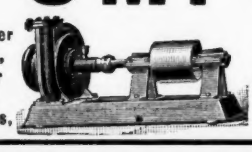

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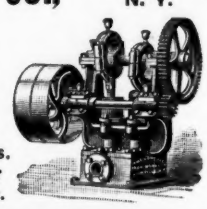

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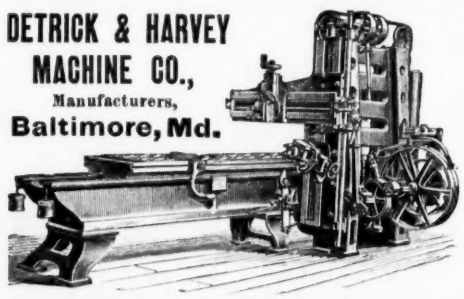

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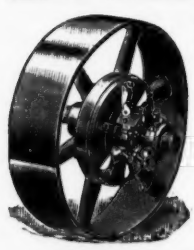

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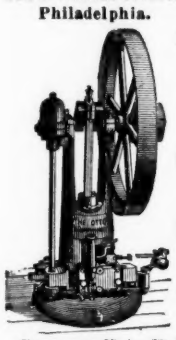

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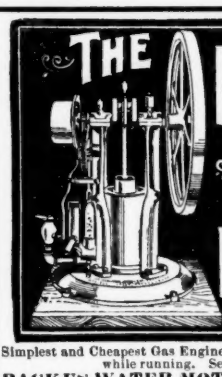

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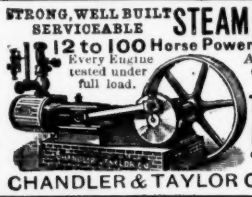

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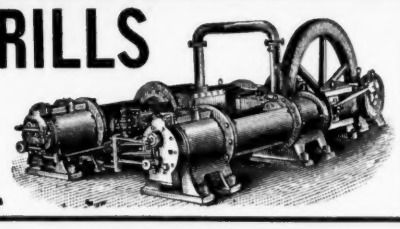

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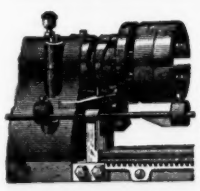

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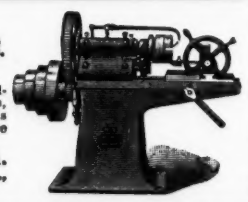

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Liberal Discount to Agents.

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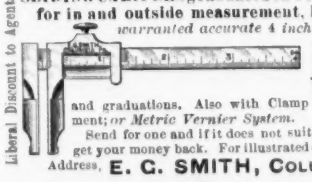

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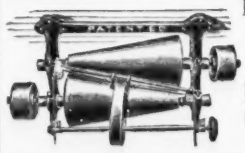

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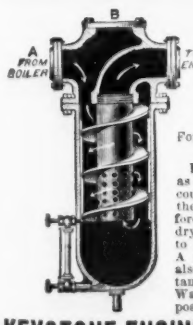

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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

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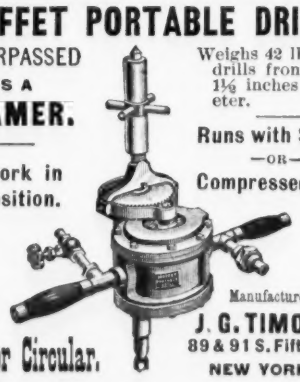

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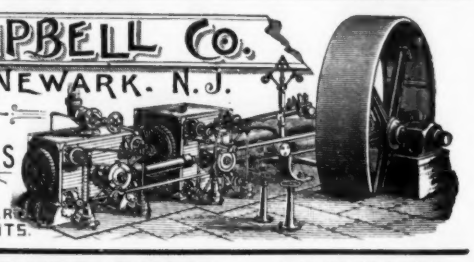

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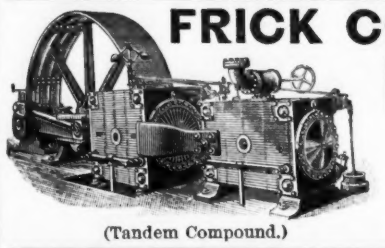

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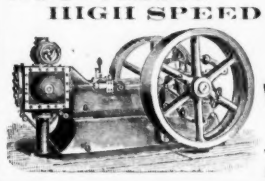

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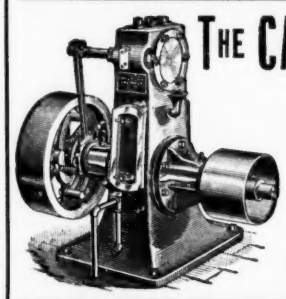

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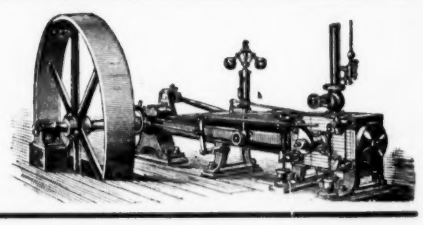

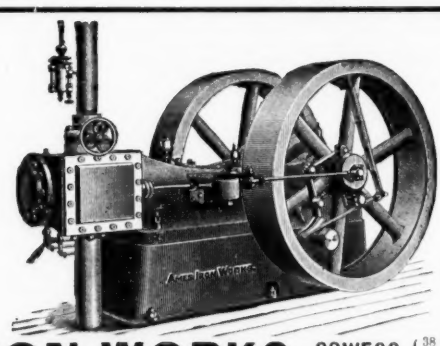

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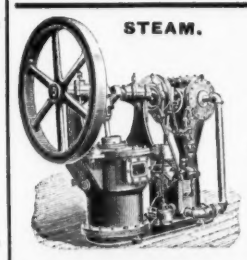

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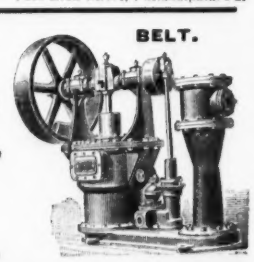

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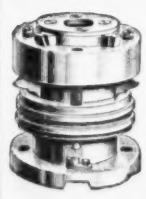

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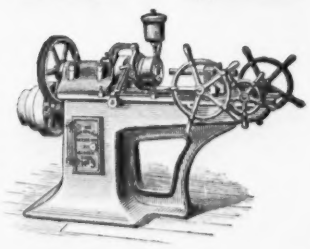

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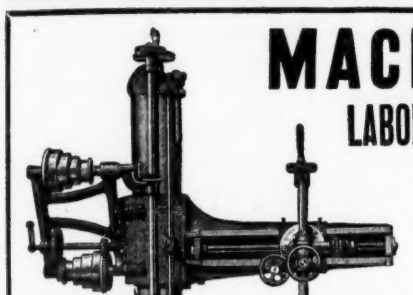

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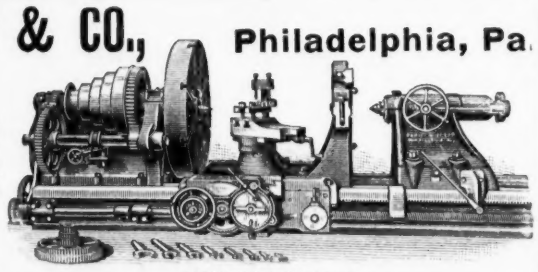

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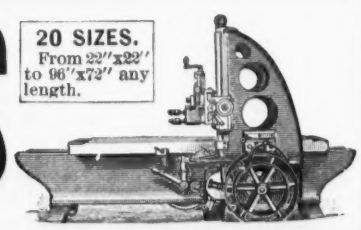

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LIKE THIS.

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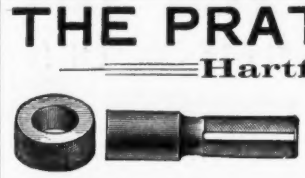

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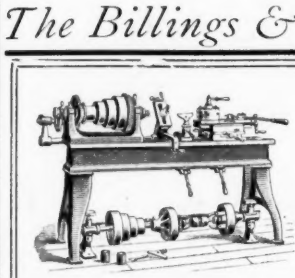

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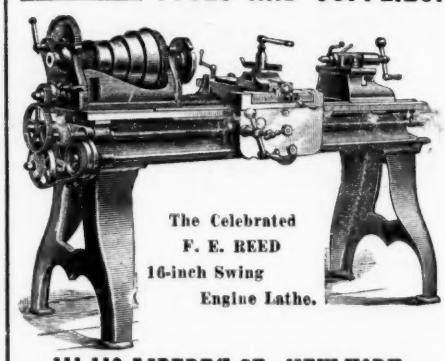

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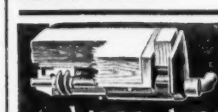

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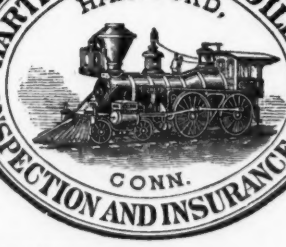

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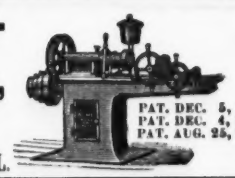

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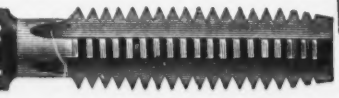

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